RENOVATIONS TO PRINCETON HIGH SCHOOL

PRINCETON PUBLIC SCHOOLS
PRINCETON - MERCER COUNTY - NEW JERSEY



Fraytak Veisz Hopkins Duthie, P.C.
New Jersey - Pennsylvania
WWW.FVHDPC.COM

FVHD PROJECT #5516A2

French & Parrello, Associates, P.A.
Consulting Engineers

February 6, 2026

S P E C I F I C A T I O N S

for
RENOVATIONS TO PRINCETON HIGH SCHOOL
located at 151 Moore Street, Princeton, NJ 08540

for the
PRINCETON PUBLIC SCHOOLS
Princeton, Mercer County, New Jersey

FVHD PROJECT NO. 5516A2

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No. 24GE04842100

NOTICE TO BIDDERS
Princton Public School District
Mercer County, New Jersey

NOTICE IS HEREBY GIVEN that the Princeton Public School District ("Owner") will receive bids for **Renovations to Princeton High School**, together with all work incidental thereto, in accordance with the requirements of the Bid Documents prepared by Fraytak Veisz Hopkins Duthie, P.C. (FVHD), Architects-Planners, www.fvhdpc.com, **FVHD Project #5516A2**.

Bids will be received for: Single Overall Contract
The Bidder shall be classified as of the date and time of the bid opening in the following discipline: DPMC: C009 Prime Contractor with C029, C030, C032, C047 Subcontractors

Bid Documents for the proposed Work are on file at the office of the Architect, Fraytak Veisz Hopkins Duthie, P.C., 1515 Lower Ferry Road, Trenton, NJ 08618, tel. 609.883.7101. Electronic Bid Documents are available from the Architect's website for no fee. Request must be made through a registered account via the FVHD Contractor Portal at https://www.fvhdpc.com/contractors. Hard copies are available for $250 per set. A check or money order should be made payable to Fraytak Veisz Hopkins Duthie, P.C. A direct shipping account number (FedEx or UPS) and preferred shipping speed must also be provided.

Prebid Meeting is scheduled for **Thursday, February 12, 2026, 3:00 PM**, at Princeton High School, 151 Moore Street, Princeton, NJ 08540. Attendance at the prebid meeting is not mandatory but highly recommended.

All Requests for Information (RFI) must be submitted in writing by **February 20, 2026**, and sent to info@fvhdpc.com, or fax to 609-883-2694 or via common carrier to the Architect at the address indicated above. All correspondence must include the Architect's Project Name and Project Number referenced. The Owner and/or the Architect are not responsible for misdirected or misrouted correspondence.

Sealed Bids are due by **Thursday, March 5, 2026, 2:00 PM**, to Princeton Public School District Administration, Attn: Andrew Harris, 25 Valley Road, Princeton, NJ 08540, and will be publicly opened and read immediately thereafter. Any Bid received after that time shall be rejected.

Bid Proposals shall be submitted in duplicate (one original and one copy) in a separate sealed envelope for each contract, addressed to the Owner, bearing the name and address of the bidder, and clearly marked "BID" with the contract title and/or bid number on the outside of the envelope. Each proposal shall be accompanied by (1) a bid bond or certified cashiers check payable to the Owner equal to 10% of the amount of the bid, but in no case to exceed $20,000 pursuant to N.J.S.A. 18A:18A-24, and (2) Certificate of Consent of Surety pursuant to N.J.S.A. 18A:18A-25, obligating the issuing surety company to provide the bidder and its subcontractors, if successful, with a NJ Statutory Performance Bond and a NJ Statutory Payment Bond each in the full amount of the contract. The Consent of Surety shall be executed by an approved surety company authorized to do business in the State of NJ and in accordance with N.J.S.A. 2A:44-143, and 2A:44-144; and must be delivered to the above place on or before the hour named. The Owner and the Architect assume no responsibility for bids mailed or misdirected in delivery.

If the bid exceeds $20,000, bidder must be pre-qualified by the New Jersey Division of Property Management and Construction (DPMC), in the above-listed classifications prior to the date that bids are received. Any Bidder and their Prime Subcontractors who do not possess a valid and active "Notice of Classification" may be ineligible to bid on this Project, and any bid submitted by such Bidder and their Prime Subcontractors may be rejected as non-responsive.

This project is subject to the New Jersey State Prevailing Wage Act, N.J.S.A. 34:11-56.27 et seq.
All bidders must comply with N.J.S.A. 10:5-31 et seq., N.J.A.C. 17:27 et seq. and N.J.S.A. 10:2-1. An Initial Project Workforce Report will be required from the successful bidder (Form AA-201).

Pursuant to "The Public Works Contractor Registration Act", N.J.S.A. 34:11-56.48 et seq., bidders and their subcontractors are required to be registered with the New Jersey Department of Labor and Workforce Development and to possess a current certificate by said Department indicating compliance with the Act prior to the time and date that bids are received. Per N.J.S.A. 52:32-44(b) all contractors and subcontractors must provide a Business Registration Certificate prior to contract award.

No bidder who is on the State Treasurer's or the Federal Government's List of Debarred, Suspended or Disqualified Bidders shall be eligible to bid on this project.

No bid may be withdrawn for a period of sixty (60) days after the date set for the opening thereof. The right is reserved to reject all bids pursuant to N.J.S.A. 18A:18A-22 and to waive minor informalities in the bidding in accordance with applicable law.

BY ORDER OF Princeton Public School District
Andrew Harris, Business Administrator/Board Secretary

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1. INVITATION TO BID

A. All Bidders are required to prepare bids in accordance with all Drawings and Specifications (Bid Documents) prepared by Fraytak Veisz Hopkins Duthie, P.C. Architects-Planners.

1. Access to Bid Documents:
   a. Requests for electronic project documentation must be made through a registered account via FVHD Architect's Contractor Portal. If you have not already done so, please visit https://www.fvhdpc.com/contractors to register.
   b. To obtain Bid Documents, you must create/register a Contractor account on the Architect's website and submit a request for Bid Documents at https://www.fvhdpc.com/contractors/bidlisting. Bid Documents are available for no fee from the Architect's website when requested through a registered account via the FVHD Contractor Portal. Hard copies may be requested at an additional fee of $150 per set. A check or money order should be made payable to Fraytak Veizs Hopkins Duthie, P.C.

B. **DISCLAIMER**: Bidders should only rely on original digital and paper versions of the Bid Documents obtained directly from the Architect's office. Fraytak Veisz Hopkins Duthie, PC (FVHD) Architects-Planners is not responsible for any unauthorized copies made of the digital or paper Bid Documents obtained from sources other than the Architect's office. All information provided by Fraytak Veisz Hopkins Duthie, PC (FVHD) Architects-Planners is intellectual property and is protected under copyright laws. It is not to be used for any purpose other than for the indicated project. Any other use or manipulation of the information is strictly prohibited.

C. Bids for Contract(s), as listed in the Advertisement for Bids or Invitation to Bid as hereinafter described, will be received for the performance of the Project. The bids shall cover all costs of any nature, incident to and growing out of the Work. In explanation but not in limitation thereof, these costs shall include the cost of all Work, labor, materials, equipment, transportation and cost of all else necessary to perform and complete the Project in the manner and within the time required, all incidental expenses in connection therewith, all costs on account of loss by damage or destruction of the Project caused by the Contractor, or Contractor's Agent, to the extent that the cost of such loss is not recovered from insurance carried by the Owner and the Contractor, and any additional expenses for unforeseen difficulties encountered, for settlement of damages and for replacement of defective Work and materials.

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D. Before submitting a Bid, the Bidder shall become familiar with the Drawings, Specifications and other documents that will form the Contract, shall investigate the site of the Project (not mandatory) and make such examination thereof as may be necessary to determine the character and amount of Work involved. The Bidder shall also determine that they can secure the necessary labor and equipment and that the materials proposed to use will comply with the requirements specified therefore and can be obtained by the Bidder in the quantities and at the time required.

1. **Site visit(s) can be arranged upon request by contacting the Architect (not mandatory): (thopkins@fvhdpc.com / dschittone@fvhdpc.com / info@fvhdpc.com).**

E. The Owner reserves the right to accept or reject all bids including Alternate Bids, if any, pursuant to N.J.S.A. 18A:18A-22 under any Contract for a period up to sixty (60) days after receipt of bids.

2. ETHICS IN PURCHASING

A. School District Responsibility

1. Recommendation of Purchases
   a. It is the desire of the Board of Education to have all Board employees and officials practice exemplary ethical behavior in the procurement of goods, materials, supplies, and services.
   b. School district officials and employees who recommend purchases shall not extend any favoritism to any vendor. Each recommended purchase should be based upon quality of the items, service, price, delivery, and other applicable factors in full compliance with N.J.S.A. 18A:18A-26 et seq.
   c. Solicitation/Receipt of Gifts - Prohibited:
      1) School district officials and employees are prohibited from soliciting and receiving funds, gifts, materials, goods, services, favors, and any other items of value from vendors doing business with the Board of Education or anyone proposing to do business with the Board of Education in accordance with N.J.S.A. 18A:12-21 et seq.

2. Vendor Responsibility:
   a. Offer of Gifts, Gratuities – Prohibited
      1) Any vendor doing business or proposing to do business with the Board of Education, shall neither pay, offer to pay, either directly or indirectly, any fee, commission, or compensation, nor offer any gift, gratuity, or other thing of value of any kind to any official or employee of the Board of Education or to any member of the official's or employee's immediate family in accordance with N.J.S.A. 18A:12-21 et seq.
   b. Vendor Influence – Prohibited:

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1) No vendor shall cause to influence or attempt to cause to influence, any official or employee of the Board of Education, in any manner which might tend to impair the objectivity or independence of judgment of said official or employee.

3. Vendor Certification:
   a. Vendors or potential vendors will be asked to certify that no official or employee of the Board of Education or immediate family members are directly or indirectly interested in this request or have any interest in any portions of profits thereof. The vendor participating in this request must be an independent vendor and not an official or employee of the Board of Education.

3. OBLIGATION OF BIDDER

A. At the time of the opening of bids, each Bidder will be presumed to have become familiar with the site (not mandatory) and to have read and to be thoroughly familiar with the Drawings, Specifications and all other Bid Documents, including all Addenda and Bulletins. The failure or omission of any Bidder to receive or examine any form, instrument or document shall not relieve Bidder from any obligation with respect to their bid. It is recommended the Bidders visit the site and acquaint themselves with the existing conditions.

B. Any and all discrepancies between the Drawings and Specifications or between trades shall be brought to the attention of the Architect prior to the Contractor's bid submission.

4. CHALLENGES TO BID SPECIFICATIONS (N.J.S.A. 18A:18A-15)

A. Any prospective Bidder who wishes to challenge a bid Specification shall file such challenges in writing with the School Business Administrator/Board Secretary no less than three (3) business days prior to the opening of bids. Challenges filed after that date shall be considered void and having no impact on the Board of Education or the award of a Contract.

5. NOTICE OF CLASSIFICATION OF BIDDERS (CONTRACTORS AND PRIME SUBCONTRACTORS)

A. Pursuant to N.J.S.A. 18A:18A-26 et seq., as amended, and N.J.A.C. 17:19-2.1 through N.J.A.C. 17:19-2.7, Bidders and their Prime Subcontractors, on any Contract on public work for a Board of Education (Owner) in the State of New Jersey in which the entire cost of the Contract exceeds $20,000.00, must:

1. Have a Classification from the Division of Property Management and Construction (DPMC), as to character and amount of public work on which they may submit bids. Bidder and their Prime Subcontractors must submit, a "Notice of Classification" setting forth the type of Work and the amount of

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Work for which the Bidder and their Prime Subcontractors have been qualified;

2. That there has been no material adverse change in their qualification information;

3. The total amount of uncompleted work on Contracts at the time and the date of the bid due date.

Any Bidder and their Prime Subcontractors who do not possess a valid and active "Notice of Classification" may be ineligible to bid on this Project, and any bid submitted by such Bidder and their Prime Subcontractors may be rejected as non-responsive. (Forms for this purpose are available from the Director of the Division of Property Management and Construction - DPMC, Trenton, New Jersey 08625.)

4. Each classified Bidder's and their Prime Subcontractor's aggregate rating shall be calculated in accordance with formula prescribed by N.J.A.C. 17:19-2.8.
   a. Calculations shall be based on Bidder's base bid amount at time of bid or total amount of base bid and accepted Alternate Bids at time of Award.

B. In accordance with N.J.S.A. 34:11-56.48 et seq. and N.J.S.A. 18A:7G-37, each Bidder must be properly registered with the New Jersey Department of Labor and Workforce Development at the time of the bid. The Contractor shall enter into Subcontracts only with Subcontractors who are registered pursuant to N.J.S.A. 34:11-56.48 et seq.

1. No Contractor/Subcontractor will be permitted to bid on or engage in any Contract for public work, as defined in the "New Jersey Prevailing Wage Act," N.J.S.A. 34:11-56.26 et seq., unless that Contractor / Subcontractor is registered with the New Jersey Department of Labor and Workforce Development at the time of the bid.

C. The Owner may make such additional investigations as it deems necessary to determine the ability of the Bidder to perform the Work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. Pursuant to N.J.S.A. 18A:18A-31, "where there have been developments subsequent to the qualifications and classification of a Bidder which in the opinion of the Owner would affect the responsibility of the Bidder, information to that effect shall forthwith be transmitted to the department for its review and reconsideration of the classification. Before taking final action on any such bid, the Owner concerned shall notify the Bidder and give them an opportunity to present to the department any additional information which might tend to substantiate the existing classification."

6. TOTAL AMOUNT OF UNCOMPLETED CONTRACTS

A. Uncompleted Contracts (For Contracts Exceeding $20,000) (N.J.A.C. 17:19-2.13(a))

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1. The Board requires that each Bidder (and their Subcontractors) submit with their bid, a certified Total Amount of Uncompleted Contracts form as prescribed by the cited regulation. (Form DPMC 701). Failure to submit this document will lead to having the bid being rejected as non-responsive.

7. CHANGES TO BID DOCUMENTS, INTERPRETATIONS AND ADDENDA

A. Changes to the Bid Documents may be required to be issued via Addenda. Fraytak Veisz Hopkins Duthie, P.C (FVHD) Architects - Planners will issue notice of the publication of all Addenda to prospective Bidders, who have obtained Bid Documents from Fraytak Veisz Hopkins Duthie, P.C (FVHD) Architects - Planners. **All Bidders may check the Fraytak Veisz Hopkins Duthie, P.C (FVHD) Architects - Planners website www.fvhdpc.com and download Addenda if any are issued for the Project.**

1. All Addenda issued become a part of the Bid Documents as though originally incorporated into the Specifications.

2. For the/all Contract(s) for construction Work, notice shall be provided no later than seven 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 in any of the following ways:
   i) in writing by certified mail or;
   ii) by certified facsimile transmission, meaning that the sender's facsimile machine produces a receipt showing date and time of transmission and that the transmission was successful or;
   iii) by a delivery service that provides certification of delivery to the sender.

3. Bidders must acknowledge receipt of all Addenda on the Bid Proposal Form or the bid shall be deemed non-responsive by the Owner.

B. Pre-bid Request for Information: No oral interpretations will be made to any Bidder as to the meaning of the Drawings and Specifications. **All Requests for Information (RFI's) must be submitted in writing by February 20, 2026 and sent by faxing to 609-883-2694; by emailing info@fvhdpc.com; or sent via common carrier to the Architect. All correspondence must include the Architect's Project Name and Project Number. The Architect is not responsible for misdirected or misrouted correspondence.**

Fraytak Veisz Hopkins Duthie, P.C.
Architects / Planners
1515 Lower Ferry Rd., Trenton, NJ 08618
Electronic Facsimile (609) 883-2694
FVHD Project No. 5516A2

1. Every interpretation made to a Bidder will be in the form of an Addendum. During the bidding period, the Architect may furnish Addenda for additions to

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or alterations of the Drawings and Specifications, which shall be included in the Work covered by the Bid Proposal Form(s).

2. Addenda, when issued, will be made available no later than seven (7) business days prior to the date for receiving bids, Saturday, Sunday or holidays excepted, to all persons who have obtained Bid Documents from the Architect.

3. Addenda will also be available for examination at the Architect's office.

4. It shall be the responsibility of the Bidder to ascertain that they have received and examined all Addenda and Bulletins issued, prior to submitting their bid. Failure of the Bidder to download and examine all Addenda shall not relieve the Bidder from any of the requirements of the Bid Documents.

5. All Addenda will be issued in accordance with N.J.S.A. 18A:18A-21(c).

8. PREPARATION OF BIDS

A. Enclose **two copies (one original and one copy)** of the Bid in a sealed envelope, identified on the outside of the envelope and clearly marked "BID" with the name and address of the Bidder, name of the Project and Contract number in which the Bidder is submitting.

B. Bids shall be submitted on the form of Bid furnished by the Architect, properly filled out and duly executed. Bid Proposal Forms shall not be altered or added to in any way. Lump Sum Bid or Base Bid prices shall be filled in, in ink or typewritten, in both words and figures. In case of discrepancy, the amount described in words shall govern.

1. **Bids containing any conditions, omissions, unexplained erasure or alteration, items not called for in the Bid Proposal Form, attachment of additive information not required by the Specifications, or irregularities of any kind may be rejected by the Owner in accordance with N.J.S.A. 18A:18A-22.**

2. **Any changes, white-outs, strike-outs, etc. on the Bid Proposal Form must be initialed in ink by the person responsible for signing the Bid Proposal Form.**

C. When the Bid is made by an individual, their post office address shall be stated and they shall sign the Bid. When made by a firm or partnership, its name and post office address shall be stated and the Bid shall be signed by one or more of the partners. When made by a corporation, its name and principal post office address shall be stated, and the Bid shall be signed by an authorized official of the corporation.

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D. Alternate Bids and Unit Prices for the various portions of Work for Contract(s) shall be as stated in other Sections of the Specifications.

1. Attention is called particularly to the requirements for filling in all Alternate Bids called for on the Bid Proposal Form, as the Owner reserves the right to award a Contract based upon the possible inclusion of one or more such Alternate Bids.

2. The amounts of the Alternate Bids shall include any and all modifications to related, adjacent or surrounding work made necessary by use of such Alternate Bids.

3. The Alternate Bids must be stated as additions to or deductions from the Base Bid, unless otherwise noted.

4. **The term "No Bid" shall not be used with respect to Alternate Bids and Unit Prices requested on the Bid Proposal Forms. The Bidder who does not desire to make a change from the Base Bid under a particular Alternate Bid shall so indicate by using the words "No Change" or "N/C." Failure to bid or use of the term "No Bid" on any Alternate shall cause rejection of entire bid.**

5. Bidders must bid on every Alternate Bid. Additions to, or deductions from, the base bid shall be indicated in the appropriate blanks on the Bid Proposal Form with additions to or deductions from the base bid filled in as appropriate. If a particular Alternate Bid does not result in an addition to or deduction from the base bid, the words "No Change" or N/C" shall be written in the blank for "No Change" on the Bid Proposal Form, and the words "No Change" shall be written in the blank provided for the purpose of stating the numeric amount in words. Failure to bid on every Alternate Bid shall render the bid nonresponsive and shall cause the bid to be rejected.

9. BID GUARANTEE

A. The Bid, when submitted, shall be accompanied by a Bid Guarantee in the form of a Certified Check, Cashier's Check or acceptable Bid Bond made payable unconditionally to the Owner, in the sum of ten percent (10%) of the Bid, but in no case in excess of $20,000.00 and as per Bid Bond Form included:

1. Bid Bond Form: Bid Bond shall be as per the form included and shall include an effective and current Power of Attorney authorizing the Attorney-in Fact to bind the Surety, on Bid Date and Time, for the full amount of the Bond.

2. Bid shall be accompanied by a Proposition of Surety in accordance with paragraph 1.10.

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B. Pursuant to N.J.S.A. 18A:18A-36, all Bid Guarantees, except those of the three apparent lowest responsible Bidders, will be returned, if requested, after ten (10) days from opening of bids, Sundays and holidays excepted. Within three (3) days after the awarding of the Contract and the approval of the Contractor's performance bond and payment bond, the bid security of the remaining unsuccessful Bidders will be returned, Sundays and holidays excepted.

C. The Bid Guarantee shall be forfeited if successful Bidder fails to execute the Agreement between Owner and Contractor identified in paragraph 1.13 hereof and furnish the Performance-Payment Bond within ten (10) days after notification of award of Contract to them (Sundays and holidays excepted).

1. Any failure by the successful Bidder to perform its obligations regarding the time, manner, and substance of compliance with Bid Documents in relation to the Award of a Contract, shall constitute an Event of Default, entitling the Owner to:
   a. Demand, from said guarantor, immediate payment of the entire Bid Bond amount, as liquidated damages, not as a penalty, for the delay which is acknowledged and agreed that the Owner will sustain in connection with said Default; and in addition thereto,
   b. Recovery of any and all other Losses incurred by the Owner, to which the Owner shall, to the fullest extent permitted by Applicable Law, be entitled to recover, including without limitation Special Damages.

10. CONTRACT BONDS

A. Prior to start of guarantee period and before the final payment is made, the Contractor shall provide the Owner with a Maintenance Bond in the amount of ten percent (10%) of Final Contract Amount, to insure the replacement or repair of defective materials or workmanship during the two-year guarantee period.

B. Proposition of Surety:

1. Pursuant to N.J.S.A. 18A:18A-25, Bids shall be accompanied by a Proposition of Surety in form as bound in these documents, assuring that satisfactory arrangements have been made between the Surety and the Bidder by which Surety agrees to furnish within ten (10) days after notification of award, Sundays and holidays excepted, of Contract, a Performance Bond and a Payment Bond; each in the amount of 100% of the amount bid.

2. The Proposition of Surety shall be executed by an approved Surety company authorized to do business in the State of New Jersey and in accordance N.J.S.A. 2A:44-143, and with the three highest rating categories of rating companies nationally recognized and listed as per Appendix A (go to www.nj.gov/dobi/surety.htm).

3. If, at any time after execution and approval of a Contract and Performance-Payment Bond required by Bid Documents, such Bond shall

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cease to be adequate security for the Owner, the Contractor shall, within five (5) days after notice to do so, furnish a new or additional Bond, in form, sum and signed by such Sureties as shall be satisfactory to the Owner. No further payment shall be deemed due nor shall any further payment be made to the Contractor unless and until such new or additional Bond shall be furnished and approved.

C. Prior to start of guarantee period and before the final payment is made, the Contractor shall provide the Owner with a Maintenance Bond in the amount of ten percent (10%) of Final Contract Amount, to insure the replacement or repair of defective materials or workmanship during the **two-year** guarantee period.

D. The cost of all Bonds shall be paid for by the Contractor and shall be included as a part of Contractor's bid price.

11. POWER OF ATTORNEY

A. Attorneys-in-fact who sign Bid Bonds, Performance-Payment Bonds, Maintenance Bonds and Proposition of Surety forms must accompany each bond or proposition with a certified and effectively dated copy of their power-of-attorney.

12. FORM OF AGREEMENT

A. The form of agreement shall be AIA Document A132/CMa Standard Form of Agreement between Owner and Contractor, Construction Manager as Advisor, 2019 Edition, and in accordance with AIA Document A232/CMa General Conditions of the Contract, Construction Manager as Advisor, 2019 Edition as amended, and all other documents referenced herein.

13. CERTIFICATE OF AUTHORITY

A. All Bidders are to submit their Sworn Contractor Certification, a current valid "Certificate of Authority" as issued by the New Jersey Department of Treasury. Reference - N.J.S.A. 18A:7G-37.

14. AWARD OF CONTRACT

A. Award, if made, will be to the lowest responsive and responsible Bidder for the Single Overall Building Contract selected to include Alternate Bids, if any, which the Owner chooses to accept, that results in the lowest aggregate total sum pursuant to N.J.S.A. 18A:18A-4.

B. Award made to a Bidder not a resident of the State of New Jersey is conditioned upon Bidder designating a proper agent in the State of New Jersey on whom service can be made in the event of litigation.

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C. If the successful Bidder is a corporation not organized under the laws of New Jersey, the award of Contract and payment of consideration thereunder shall be conditioned upon the Corporation procuring a certificate of authority to transact business in the State of New Jersey pursuant to N.J.S.A. 14A:13-3 and complying with the provisions of N.J.S.A.14A:13-4.

D. NJ Business Registration Certificate:

1. Pursuant to N.J.S.A. 52:32-44, Princeton Public Schools ("Owner") is prohibited from entering into a Contract with an entity unless the Bidder/proposer/Contractor, and each Subcontractor that is required by law to be named in a bid/proposal/Contract has a valid Business Registration Certificate on file with the Division of Revenue and Enterprise Services within the Department of the Treasury.

2. Prior to Contract award or authorization, the Contractor shall provide the Owner with its proof of business registration and that of any named Subcontractor(s).

3. Subcontractors named in a bid or other proposal shall provide proof of business registration to the Bidder, who in turn, shall provide it to the Owner prior to the time a Contract, purchase order, or other Bid Document is awarded or authorized.

4. During the course of Contract performance:
   a. the Contractor shall not enter into a Contract with a Subcontractor unless the Subcontractor first provides the Contractor with a valid proof of business registration.
   b. the Contractor shall maintain and submit to the Owner a list of Subcontractors and their addresses that may be updated from time to time.
   c. the Contractor and any Subcontractor providing goods or performing services under the Contract, and each of their affiliates, shall collect and remit to the Director of the Division of Taxation in the Department of the Treasury, 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 the State. Any questions in this regard can be directed to the Division of Taxation at (609)292-6400. Form NJ-REG can be filed online at http://www.state.nj.us/treasury/revenue/busregcert.shtml.

5. Before final payment is made under the Contract, the Contractor shall submit to the Owner a complete and accurate list of all Subcontractors used and their addresses.

6. 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, or that provides false business registration information, shall be liable for a penalty of $25 for each day of

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violation, not to exceed $50,000, for each proof of business registration not properly provided under a Contract with the Owner.

7. Emergency Purchases or Contracts
   a. For purchases of an emergent nature, the Contractor shall provide its Business Registration Certificate within two weeks from the date of purchase or execution of the Contract or prior to payment for goods or services, whichever is earlier.

E. The Owner reserves the right to reject all bids, or to waive minor informalities or non-material exceptions in a bid, pursuant to applicable law.

F. In accordance with requirements of the N.J.S.A. 18A:18A-36(b), execution of the Contract by all parties will be done within 21 days of the notification of the award date, Sundays and holidays excepted, after making the award.

1. The Bidder to whom the Contract is awarded shall be required to execute said Contract within twenty (20) calendar days of the notification of the award to them, Sundays and holidays excepted, after making the award.

G. Upon award of the Contract, the Contractor shall execute and return to the Owner the "Contractor Certification and Consent Upon Award of Contract," attached to the Contract as an Exhibit.

H. The award of the Contract is subject to availability and appropriation of sufficient funds.

15. BID PROTESTS AND CONTRACTOR'S RESPONSIBILITY

A. Contractors may contact the Purchasing Agent in writing, when they feel it necessary to challenge a procurement Specification item or to protest an award of Contract. All challenges and protests will be reviewed by the Purchasing Agent, the District Administrator of the Contract and the Board Attorney. All determinations shall be made in writing to the Contractor. The Purchasing Agent pursuant to N.J.S.A. 18A:18A-2 (b) is the School Business Administrator.

B. A bid protest filed shall:

1. Include the name, street address, electronic mail address, and telephone and facsimile numbers of the protester;

2. Be signed by the protester or its representative;

3. Identify the bid or solicitation number and date of bid or solicitation;

4. Include a detailed statement of the legal and factual grounds of protest including copies of relevant documents;

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5. Set forth all information establishing that the protester is an interested party for the purpose of filing a protest;

6. Set forth all information establishing the timeliness of the protest; and

7. Provide any or all information pertaining to the bid protest.

16. BID DOCUMENTS

A. The Bid Documents consist of but not limited to the following:

1. Instructions To Bidders in accordance with this Section,

2. General Conditions, AIA Document A232, and as supplemented in the Supplementary General Conditions; Section 00800,

3. Bid Form including attachments as per Bidder's Checklist,

4. Addenda, if issued,

5. Specifications: As outlined in the "Index" included in the Project Manual,

6. Drawings: As per List of Drawings indicated on Project Title Sheet and in accordance with Section 00850,

7. Agreement Between Owner & Contractor, AIA Document A132 and as amended by the Project Specifications.

B. Note: The above list is not intended to establish order of precedence.

17. TIME OF COMPLETION AND LIQUIDATED DAMAGES

A. Refer to Section 01800, "Time of Completion and Liquidated Damages".

18. LISTING OF STOCKHOLDERS, PARTNERS OR MEMBERS (N.J.S.A. 52:25-24.2)

A. Statement of Ownership

1. No business organization, regardless of form of ownership, shall be awarded any Contract for the performance of any work or the furnishing of any goods and services, unless, prior to the receipt of the bid or accompanying the bid of said business organization, Bidders shall submit a statement setting forth the names and addresses of all persons and entities that own ten (10%) percent or more of its stock or interest of any type at all levels of ownership.

2. The included Statement of Ownership shall be completed and attached to the bid proposal. This requirement applies to all forms of business organizations,

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including, but not limited to, corporations and partnerships, publicly-owned corporations, limited partnerships, limited liability corporations, limited liability partnerships, sole proprietorship, and Subchapter S corporations. Failure to submit a disclosure document shall result in rejection of the bid as it cannot be remedied after bids have been opened.

3. Not-for-profit entities should fill in their name, check the not-for-profit box, and certify the form. No other information is required.

19. NON-COLLUSION AFFIDAVIT

A. The Bidder shall submit the Non-Collusion Affidavit, on form as bound herein, must be submitted with the bid. Failure to submit this document may lead to having the bid being rejected as non-responsive.

20. FALSE MATERIAL REPRESENTATION / TRUTH IN CONTRACTING

A. 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. Bidder should be aware of the following statutes that represent "Truth in Contracting" laws:

1. 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.

2. 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.

3. Bidder should consult the statutes such as N.J.S.A. 18A:7G-39 or legal counsel for further information.

21. EQUIVALENT PRODUCTS

A. The use of manufacturers' brand names, catalogue numbers and similar proprietary identifying data in the Bid Documents are not intended to eliminate from consideration products that are equivalent in quality, appearance and function to those specified.

22. CONTRACT

A. As indicated in the Advertisement for Bids, the Owner is intended to receive sealed

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bids and to award and administer the Contract for the work required by the Bid Documents as follows:

Single Overall Contract

B. The Bidder shall be a firm classified by the State of New Jersey - Division of Property Management and Construction for the following classification:

Prime General Contractor
C009 - General Construction/Alterations and Additions
and have Subcontractor(s) for the following classification(s) of work:

Subcontractors:
C029 - Structural Steel & Ornamental Iron
C030 - Plumbing
C032 - HVACR
C047 - Electrical

C. **Pursuant to N.J.S.A. 18A:18A-26, the Bidder shall be in possession of the required DPMC Classification for the specified Work.**

1. **In the case of a Combined Single Overall Bid, if the Contractor possess the DPMC Classification in one category, but not in all of the required categories, the Contractor must list the Prime Subcontractor(s) bidding the scope of work for the other categories. The Subcontractor(s) must possess the DPMC Classification(s) in that category.**

END OF SECTION 00100

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BID PROPOSAL FORM

SINGLE OVERALL CONTRACT

DPMC Classifications: C009 Prime Contractor
with C029, C030, C032 & C047 Subcontractors

To: Princeton Public Schools
25 Valley Road
Princeton, NJ 08540

1. The undersigned, having familiarized themself with the local conditions affecting the cost of the work, the Drawings, the Specifications and other Bid Documents, as in the Advertisement for Bids thereto, for the **Renovations to Princeton High School (FVHD#5516A2)**, 151 Moore Street, Princeton, NJ 08540, together with all work incidental thereto, in accordance with the requirements of the Drawings and Specifications prepared by Fraytak Veisz Hopkins Duthie, P.C., Architects/Planners, Trenton, New Jersey, hereby proposes to furnish all labor, materials and equipment required for all Work and as follows:

   SINGLE OVERALL CONTRACT - BASE BID: All Work at the above referenced school, including applicable Allowances - Section 01020, in accordance with the requirements of Bid Documents. If written amount differs from the numerical figure, only the written amount will be accepted as the correct bid.

   TOTAL BASE BID INCLUDING ALLOWANCE: $_____
   (Numerical)

   _____
   (To be written in full)

2. **Alternate Proposal(s) - Section 01030** shall be quoted as additions to, deductions from or No Change (NC) to the Base Bid and shall be in accordance with the Specifications for Alternate Bid Work. If written amount differs from the numerical figure, only the written amount will be accepted as the correct bid.

   Alternate Bid No. 1: Epoxy Floor System ADD $_____
   (Numerical)

   _____
   (To be written in full)

THE REMAINDER OF THIS PAGE WAS INTENTIONALLY LEFT BLANK

Submitted by:_____
(Firm Name)

3. **UNIT PRICES - SECTION 01151: Materials in Place.**

UNIT PRICES - GENERAL CONSTRUCTION: Materials in Place.

Cement Based Self Leveling Underlayment per Section 03452	$_____ per sq. ft.

UNIT PRICES - PLUMBING & FIRE SUPPRESSION: Materials in Place.

2″ cast iron pipe below grade	$_____ per lin. ft.
3″ cast iron pipe below grade	$_____ per lin. ft.
4″ cast iron pipe below grade	$_____ per lin. ft.
2" cast iron above grade	$_____ per lin. ft.
1/2″ Type 'L' copper tubing	$_____ per lin. ft.
3/4″ Type 'L' copper tubing	$_____ per lin. ft.
2″ Type 'L' copper tubing	$_____ per lin. ft.
1/2" piping insulation	$_____ per lin. ft.
3/4" piping insulation	$_____ per lin. ft.
2" piping insulation	$_____ per lin. ft.
1/2" Ball valve	$_____ per unit
1-1/2" Ball valve	$_____ per unit
2" Ball valve	$_____ per unit
Thermostatic mixing valve MV-1	$_____ per unit
Water Heater	$_____ per unit
Sewage Ejector	$_____ per unit
Floor drain FD-1	$_____ per unit
Sprinkler head with associated 1″ branch piping (approx.. 5'-0″ length)	$_____ per unit

UNIT PRICES - HEATING AND VENTILATING: Materials in Place.

3/4″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints	$_____ per lin. ft.
3/4" piping insulation	$_____ per lin. ft.
1″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints	$_____ per lin. ft.
1" piping insulation	$_____ per lin. ft.
1 1/2″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints	$_____ per lin. ft.
1 1/2" piping insulation	$_____ per lin. ft.
Condensate pump	$_____ each

Submitted by:_____
(Firm Name)

12"X8" Volume damper	$_____ each
24″x24″ ceiling diffuser	$_____ each
24″x24″ ceiling register	$_____ each
24″x12″ ceiling registers	$_____ each
24″x14″ Supply Grilles	$_____ each
Unitary controller	$_____ each
Thermostat	$_____ each
Ball valve, under 1″	$_____ each
Ball Valve, 1″	$_____ each
Ball Valve, 1 ½″	$_____ each
Balancing Valve, 1″	$_____ each
Balancing Valve, 1 ½″	$_____ each
Galvanized Steel Ductwork (Rectangular) 20"X12"	$_____ per lb.
Single-Wall Round Ductwork 12" diameter	$_____ per lb.
Double-Wall Round Ductwork 12" diameter	$_____ per lb.
1 1/2" Mineral-Fiber Board Duct Insulation (Indoors)	$_____ per sq. ft.
2" Mineral-Fiber Blanket Duct wrap Insulation (Indoors)	$_____ per sq. ft.
2" Mineral-Fiber Board Duct Insulation (Outdoors)	$_____ per sq. ft.

UNIT PRICES - ELECTRICAL: Materials in Place.

20A-1 Pole branch circuit installation 600V, including MC cable and termination.	$_____ per lin. ft.
20A-1 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
30A-3 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
50A-3 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
60A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
70A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
80A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.
90A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____ per lin. ft.

Submitted by:_____
(Firm Name)

100A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____	per lin. ft.
150A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____	per lin. ft.
200A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination.	$_____	per lin. ft.
20A Tamper-resistant receptacle including back box, plate, conduit and wiring to the nearest device(20')	$_____	each
20A Tamper-resistant GFCI receptacle including back box, plate, conduit and wiring to the nearest device(20')	$_____	each
20A Single pole light switch including back box, plate, conduit and wiring to the nearest device(20')	$_____	each
20A Single pole three way light switch including back box, plate, conduit and wiring to the nearest device(20')	$_____	each
Fire Alarm smoke/heat detector including wiring, programming, and testing.	$_____	each
Fire Alarm duct smoke detector including wiring, programming, and testing.	$_____	each
Fire Alarm Horn/strobe including wiring, programming, and testing.	$_____	each
Fire Alarm monitor/control module including wiring, programming, and testing.	$_____	each
Fire Alarm door holder including wiring, programming, and testing.	$_____	each
Fire Alarm Pull station including wiring, programming, and testing.	$_____	each
Fire Alarm Device Wire mesh device guard.	$_____	each
Junction Box and 3/4" Empty conduit with drag line and bushing at each end	$_____	per lin. ft.
Junction Box and 1" Empty conduit with drag line and bushing at each end	$_____	per lin. ft.
Junction Box and 2" Empty conduit with drag line and bushing at each end	$_____	per lin. ft.
(1) Ceiling mounted occupancy sensor as indicated on contract drawings.	$_____	each
(1) Wall switch occupancy sensor as indicated on contract drawings.	$_____	each
Combination Voice & Data communication outlet including backbox, wall plate, conduit, and Cat6 cable to IDF room	$_____	each

Submitted by:_____
(Firm Name)

4. Bidder hereby acknowledges receipt of the following Addenda:
   No Addenda Issued ☐
   Addendum No.___, issued_____ received_____(initial)
   Addendum No.___, issued_____ received_____(initial)
   Addendum No.___, issued_____ received_____(initial)
   Addendum No.___, issued_____ received_____(initial)

5. In submitting this bid, it is understood that the right is reserved by the Owner to accept or to reject bids pursuant to N.J.S.A. 18A:18-22 and any bid that is non-responsive or submitted by a Bidder that is not responsible, and it is agreed that this bid may not be withdrawn for a period of sixty (60) days from the date set of the opening thereof.

6. Bid Security in the sum of _____ ($_____) in the form of _____ (Certified Check, Cashier's Check, or Bid Bond) is submitted herewith in accordance with the requirements of the Specifications.

7. The undersigned is an individual ( )
   a partnership ( )
   a corporation ( ) under the laws of the State of _____,
   having principal office in the _____ of _____, County of _____, and State of _____.

Respectfully Submitted,

_____
(Company Name, if Bidder is a company)

BIDDER'S SIGNATURE

_____
(Company Officer, if Bidder is a Corporation or LLC)

(Seal, if Corporation)

_____
Printed or Typed Name Title of Officer (if the Bidder is a Company)

_____
Address

_____
City, State, Zip Code

_____
Phone & Fax

_____
Dated

_____
Email Address

NOTE: SEE BIDDERS CHECKLIST

Submitted by:_____
(Firm Name)

BIDDER'S CHECKLIST

The following checklist must be signed and submitted with the bid package to the Owner as part of the Bid Documents. Bidders are encouraged to submit all items listed below with the bid. All must be provided prior to award of the contract. Failure to submit documents marked (*) mandatory may be cause for rejection of the bid.

	Reviewed the Bid Documents (Including the permits obtained by the Owner), satisfied themselves regarding the character of the reviewed locality, and all local conditions and Laws and Regulations That in any manner may affect cost, progress, performance or furnishing of work.	
	Reviewed General Bond Requirements	
	Reviewed the Contract Documents contained herein (Owner/Contractor)	
	ITEM	
(*)	Bidder's Proposal	
(*)	Bid Bond, Certified Check, Cashier's Check or Any Combination Thereof in an Amount of Ten Percent (10%) of the Total Amount of Bid, Not to Exceed $20,000 (Twenty Thousand Dollars) with Power of Attorney	
(*)	Consent of Surety for 100% of the Contract Amount with Power of Attorney to Provide Performance Bond and Labor and Material Payment Bond If Surety is being provided for Subcontractors by Bidder, indicate here _____ Initial	
(*)	Subcontractor Identification List	
(*)	Statement of Ownership Disclosure Certification	
(*)	Division of Property Management & Construction (DPMC) Form 701 - Total Amount of Uncompleted Contracts, N.J.A.C. 17:19-2.13 All Contractor(s) and Named Subcontractor(s)	
(*)	Division of Property Management & Construction (DPMC) Current Notice of Classification - All Contractor(s) and Named Subcontractor(s)	
(*)	Non Collusion Affidavit	
(*)	Equipment Certification	
(*)	Certification of No Material Change of Circumstances - All Contractor(s) and Named Subcontractor(s)	
	Prevailing Wage Certification	
	Sworn Contractor Certification	
	Public Works Contractors Registration Act Certificate (N.J.S.A. 34:11-56.48) All Contractor(s) and Named Subcontractor(s)	
	Business Registration Certificate - All Contractor(s) and Named Subcontractor(s)	
	Federal and State Non-debarment Certifications - All Contractor(s) and Named Subcontractor(s)	

BIDDER'S CHECKLIST

	Certification of Non-Debarment for Federal Government Projects - All Contractor(s) and Named Subcontractor(s)	
	Trade License - All Contractor(s) and Named Subcontractor(s)	
	HVACR Master License (HVACR Contractors)	
	Compliance with New Jersey Prevailing Wage Act	
	Certification of Insurance Statement	
	Political Contribution Disclosure Form	
	Prohibited Russia-Belarus Activities & Iran Investment Activities	
	Americans with Disabilities Act Language	
	Mandatory Equal Employment Opportunity Language	
	EEO/AA Form AA-201	
	Status of Present Contracts	
	Performance Record Certification	
	Contractor(s) shall participate in an "apprenticeship training program" and shall submit evidence of same and/or a description of the Contractor's apprenticeship training program prior to the award of the Contract.	

By signing below, I acknowledge having read and fully understand all the requirements of each of the documents referenced herein.

_____
BIDDER (Signature)

Dated:_____

_____
BIDDER (Print Name)

SAMPLE
BID BOND

Bond No._____

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

_____ as Principal, and _____ as Surety,
[Full Legal Name of Bidder] [Name of Surety Company]

are bound to _____ as Obligee, in the sum of
[Name of Public Agency]

_____ Dollars ($_____),
[Percentage of Bid or Not-to-Exceed Amount]

for which we bind ourselves and our successors.

The Principal has submitted a bid to the Obligee on _____ for the project.
[Date of Bid]

_____ .
[Name of Project and Bid Number]

This bond's condition is that if the Obligee awards the contract to the Principal, and the Principal within the specified time executes the contract and provides any required performance/payment bonds according to bid specifications and N.J.S.A. 2A:44-143 et seq., then this obligation is void. Otherwise, the Principal and Surety are obligated to the Obligee for the difference between the Principal's bid and the amount for which the Obligee contracts with another party. If the Principal fails to execute the contract and furnish required bonds, the Surety will pay the bond amount as liquidated damages.

The Surety agrees that its obligations remain in effect.

This instrument was executed on the _____ .
[Date] day of [Month], 20**[Year]**

PRINCIPAL (BIDDER):
(Full Legal Name of Bidder)

By: _____

Name: _____
(Name of Authorized Representative)

Title: _____
(Title of Authorized Representative)

SURETY:
(Name of Surety Company)

By: _____

Name: _____
(Name of Attorney-in-Face)

Title: _____
(Attorney-in-Fact)

[Corporate Seal]

- Complete document and affix Corporate Seal
- This Bid Bond Must be accompanied by a Power of Attorney for the Attorney-in-Fact which is currently dated and valid for the entire amount of the Bond

CERTIFICATE

(to be completed by an authorized certifying agent for each surety on the bond)

I ..... (name of agent), as ..... (title of agent) for ..... (name of surety), a corporation/mutual insurance company/other (indicating type of business organization) (circle one) domiciled in (state of domicile),

DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOIDABLE.

.....
(Signature of certifying agent)

.....
(Printed name of certifying agent)

.....
(Title of certifying agent)

Consent of Surety

The _____

_____

_____

(Name and Address of Surety)

a corporation existing under the Laws of the State of _____ and authorized to do business under the Laws of the State of New Jersey, hereby certifies that application has been made to us by

_____

_____

_____

(Name and Address of Contractor)

and satisfactory arrangements have been completed by which we have and do now agree to furnish a Performance Bond equal to 100% of the Contract to ensure the faithful performance on the part of the Bidder of the terms and conditions of the contract, and a labor and materials bond to ensure the payment of all persons furnishing labor and materials in accordance with the contract.

Title Work: _____

Name and Location of Project: _____

This proposition is made with the understanding that any change made in the specifications or agreements without the consent of the bondsmen shall in no way vitiate the bond.

WITNESS: SURETY COMPANY

_____ _____

Title:_____
Attorney-in-fact

By:_____

Date:_____

(Affix corporate seal)

Important Note:

The Surety Company executing the Bond must be authorized to transact business in the State of New Jersey. For contracts in excess of $850,000, the surety shall be listed on the New Jersey List of Approved Sureties, located at www.state.nj.us/dobi/surety.htm.

SURETY DISCLOSURE STATEMENT AND CERTIFICATION
N.J.S.A. 2A:44-143

....., surety(ies) on the attached bond, hereby certifies(y) the following:

(1) The surety meets the applicable capital and surplus requirements of R.S.17:17-6 or R.S.17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital (where applicable) and surplus, as determined in accordance with the applicable laws of this State, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ended December 31, (most recent calendar year for which capital and surplus

amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety's capital and surplus amounts, together with the name and address of the firm of certified public accounts that shall have certified those amounts):

.....

.....

.....

(3) (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each such surety that surety's underwriting limitation and the effective date thereof):

.....

.....

.....

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to R.S.17:18-9 as of (date on which such limitation was so established) is as follows (indicating for each such surety that surety's underwriting limitation and the date on which that limitation was established):

.....

.....

.....

(4) The amount of the bond to which this statement and certification is attached is $ .....

(5) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3)(a) or (3)(b) above, or both, then for each such contract of reinsurance:

(a) The name and address of each such reinsurer under that contract and the amount of that reinsurer's participation in the contract is as follows:.....

.....

.....

.....; and

(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under P.L.1993, c.243 (C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

(continued)

CERTIFICATE

(to be completed by an authorized certifying agent for each surety on the bond)

I ..... (name of agent), as ..... (title of agent) for (name

of surety), a corporation/mutual insurance company/other (indicating type of business organization) (circle one) domiciled in (state of domicile), DO HEREBY CERTIFY that, to the best of my

knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOIDABLE.

.....
(Signature of certifying agent)

.....
(Printed name of certifying agent)

.....
(Title of certifying agent)

SUBCONTRACTOR IDENTIFICATION LIST

Project Title: _____ **Project #:**_____

The following information is to be provided in the case of all subcontractors who will furnish labor of the various trades governed by N.J.S.A. 18A:18A-18(b) [General Construction, Steel, Plumbing, HVAC, Electric].

Trade	Company Name/Address/Telephone/Fax/Email	NJ License No.

If work of the types designated by the above referenced law will be performed by the Bidder, the Bidder shall state below and shall enclose copies of licenses covering each trade.

Trade	N.J. License No.

_____ _____ _____

Bidder - Company Name | Signature of Authorized Representative | Date

STATEMENT OF OWNERSHIP DISCLOSURE

N.J.S.A. 52:25-24.2 (P.L. 1977, c.33, as amended by P.L. 2016, c.43)

This statement shall be completed, certified to, and included with all bid and proposal submissions.

Name of Organization: _____

Organization Address: _____

City, State, ZIP: _____

Part I Check the box that represents the type of business organization:

☐ Sole Proprietorship (skip Parts II and III, execute certification in Part IV)

☐ Non-Profit Corporation (skip Parts II and III, execute certification in Part IV)

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

☐ Partnership ☐ Limited Partnership ☐ Limited Liability Partnership (LLP)

☐ Other (be specific): _____

Part II Check the appropriate box

☐ The list below contains 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 owns a 10 percent or greater interest therein, as the case may be. (**COMPLETE THE LIST BELOW IN THIS SECTION**)

OR

☐ No one stockholder in the corporation owns 10 percent or more of its stock, of any class, or no individual partner in the partnership owns a 10 percent or greater interest therein, or no member in the limited liability company owns a 10 percent or greater interest therein, as the case may be. (**SKIP TO PART IV**)

(Please attach additional sheets if more space is needed):

Name of Individual or Business Entity	Address

Part III DISCLOSURE OF 10% OR GREATER OWNERSHIP IN THE STOCKHOLDERS, PARTNERS OR LLC MEMBERS LISTED IN PART II

If a bidder has a direct or indirect parent entity which is publicly traded, and any person holds a 10 percent or greater beneficial interest in the publicly traded parent entity as of the last annual federal Security and Exchange Commission (SEC) or foreign equivalent filing, ownership disclosure can be met by providing links to the website(s) containing the last annual filing(s) with the federal Securities and Exchange Commission (or foreign equivalent) that contain the name and address of each person holding a 10% or greater beneficial interest in the publicly traded parent entity, along with the relevant page numbers of the filing(s) that contain the information on each such person. **Attach additional sheets if more space is needed**.

Website (URL) containing the last annual SEC (or foreign equivalent) filing	Page #'s

Please list the names and addresses of each stockholder, partner or member owning a 10 percent or greater interest in any corresponding corporation, partnership and/or limited liability company (LLC) listed in Part II other than for any publicly traded parent entities referenced above. 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 pursuant to N.J.S.A. 52:25-24.2 has been listed. Attach additional sheets if more space is needed.

Stockholder/Partner/Member and Corresponding Entity Listed in Part II	Address

Part IV Certification

I, being duly sworn upon my oath, hereby represent that the foregoing information and any attachments thereto to the best of my knowledge are true and complete. I acknowledge: that I am authorized to execute this certification on behalf of the bidder/proposer; that the _____ (Owner) is relying on the information contained herein and that I am under a continuing obligation from the date of this certification through the completion of any contracts with Owner to notify the Owner 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, permitting the Owner to declare any contract(s) resulting from this certification void and unenforceable.

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

This statement shall be completed, certified to, and included with all bid and proposal submissions. Failure to submit the required information is cause for automatic rejection of the bid or proposal.

CERTIFICATION OF NO MATERIAL CHANGE OF CIRCUMSTANCES

Bidder's Name: _____

Address: _____

1. A statement as to the financial ability, adequacy of plant equipment, organization and prior experience of the Bidder, as required by N.J.S.A. 18A:18A-28 has been submitted to the Department of Treasury within the last twelve (12) months preceding the date of opening of bids for this contract.

2. I certify, as required by N.J.S.A. 18A:18A-32, that there has been no material adverse change in the qualification except:

   _____

   _____

   _____

   _____

_____
(Name and Title of Signer - Please print or type)

_____ _____
(Signature) (Date)

NON-COLLUSION AFFIDAVIT

STATE OF NEW JERSEY/_____
(Specify, if Other)

COUNTY OF _____

I, _____ , of the (City, Town, Borough) of

_____State of _____ , of full age, being duly sworn according to law on my oath depose and say that:

I am _____ of the firm of _____, the Bidder making the Proposal for the above named Projects, and that I executed the said Proposal with full authority to do so; that said Bidder 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 Project; and that all statements contained in said Proposal and in this affidavit are true and correct, and made with full knowledge, and the State of New Jersey relies upon the truth of the statements contained in this affidavit in awarding the contract for the said Project.

I further warrant that no person or selling agency 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 bona fide employees or bona fide established commercial or selling agencies maintained by _____ . (Name of Contractor)

By: _____
(Signature of Authorized Representative)

Subscribed and sworn to before me
this _____ day of _____, 20___.

_____

(Seal) Notary Public of New Jersey/
Specify Other State
My Commission Expires _____, 20___.

THIS FORM MUST BE COMPLETED, SIGNED, NOTARIZED, AND SUBMITTED WITH BID

EQUIPMENT CERTIFICATION

Title of Bid: _____

Bid No. _____ Bid Date: _____
(Weekday, Month 00, 20__)

In accordance with N.J.S.A. 18A:18A-23, I hereby certify that

A) _____ *(Name of Company)* owns all the necessary equipment as required by the specifications and to complete the specified public work project.

or

B) _____ *(Name of Company)* leases or controls all the necessary equipment as required by the specifications and to complete the specified public work project.

PLEASE NOTE: If your company is not the actual owner of the equipment, **you shall submit with the bid**

1. A certificate stating the source from which the equipment will be obtained and
2. Obtain and submit with the bid a certificate from the owner and person in control of the equipment, definitely granting to the bidder the control of the equipment required during such time it may be necessary for the completion of that portion of the contract for which said equipment will be necessary.

Name of Company _____

Authorized Agent _____ Title _____

Authorized Signature _____

Compliance with New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25 et seq.)

Every Contractor and Subcontractor performing services in connection with this Project, shall pay all workers a wage rate not less than the published prevailing wage rates, for the locality the work is being performed, as designated by the New Jersey Department of Labor and Workforce Development (NJ DLWD).

Wage rates for the county of the location of the Public Agency (Owner), as published by the State Department of Labor and Workforce Development (DLWD), can be viewed at https://www.nj.gov/labor/wagehour/wagerate/prevailing_wage_determinations.html

The Contractor must complete and sign the "Prevailing Wage Certification" form included in the bid package and submit with his bid. This form confirms the Contractor's intention to comply with the Act. The Owner may terminate the contract if Contractor fails to pay workers prevailing wage. The prevailing wage rates in affect at the time of award, will be included by Owner as a part of the construction contract.

Public Law S-1442/A-5345, now P.L. 2023, c. 138, requires public works contractors to register and certify payroll for public works projects to be completed online at https://njwage.nj.gov

PREVAILING WAGES COMPLIANCE CERTIFICATION

It is the determination that this is a public works project that in total will exceed $2,000.00 (two thousand dollars), therefore prevailing wages rules and regulations apply as promulgated by the New Jersey Prevailing Wage Act and in conformance with N.J.S.A. 34:11-56:25 et seq.

Certification

1. I certify that our company understands that this project requires prevailing wages to be paid in full accordance with the law.

2. I further certify that all subs named in this bid understand that this project requires the sub to pay prevailing wages in full accordance with the law.

Non-compliance Statement

If it is found that any worker, employed by the Contractor or any Subcontractor covered by said contract, has been paid a rate of wages less than the prevailing wage required to be paid by such contract, the Owner, may begin proceedings to terminate the Contractor'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 Contractor and his sureties shall be liable for any excess costs occasioned thereby to the public body.

NOTIFICATION OF VIOLATIONS – New Jersey Department of Labor and Workforce Development

Has the Bidder or any person having an "interest" with the Bidder, been notified by the New Jersey Department of Labor and Workforce Development by notice issued pursuant to N.J.S.A. 34:11-56a et seq that he/she has been in violation for failure to pay prevailing wages as required by the New Jersey Prevailing Wage Act within the last five (5) years?

*Yes_____ No_____

*If yes, please attach a signed document explaining any/or all administrative proceedings with the Department within the last five (5) years. Please include any pending administrative proceedings with the Department if any.

Submission of Certified Payroll Records

NJ Public Law S-1442/A-5345, now P.L.2023, c.138, requires public works contractors to register and certify payroll online for public works projects at https://njwages.nj.gov.

Name of Company _____

Authorized Agent _____

Authorized Signature _____

CERTIFICATION OF NON-DEBARTMENT FOR
FEDERAL GOVERNMENT CONTRACTS
N.J.S.A. 52:32-44.1 (P.L. 2019, c.406)

Public Works Contracts

Project No._____ Title of Bid_____

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 ☐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 _____ **("OWNER")** 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 **"OWNER"** to notify the **"OWNER"** 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 **"OWNER"**, permitting the **"OWNER"** 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	
Section A	
☐	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	
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	
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.

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 _____ ***(name of organization)***. I further acknowledge: that I am authorized to execute this certification on behalf of the above-named organization; that the **("OWNER")** 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 **"OWNER"** to notify the **"OWNER"** 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 **"OWNER"**, permitting the **"OWNER"** 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

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 of Non-Debarment

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 **("OWNER")** 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 **"OWNER"** to notify **"OWNER"** 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 **"OWNER"**, permitting the **"OWNER"** to declare any contract(s) resulting from this certification void and unenforceable.

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

FEDERAL AND STATE NON-DEBARMENT CERTIFICATIONS

I, _____ of the city of _____, in the County of _____ and the State of _____, of full age, certify that the entity listed on the form and/or any person or company employed by this entity, are not presently on the following:

- New Jersey Department of Treasury – Consolidated Debarment Report
- New Jersey Department of Labor – Prevailing Wage Debarment List
- Federal Debarred Vendor List – System for Award Management (SAM.gov)
- Workplace Accountability in Labor List (The Wall)

Company Name: _____

Authorized Agent: _____

Signature: _____

Date: _____

C. 271 POLITICAL CONTRIBUTION DISCLOSURE FORM

Contractor Instructions

Business entities (contractors) receiving contracts from a public agency that are NOT awarded pursuant to a "fair and open" process (defined at N.J.S.A. 19:44A-20.7) are subject to the provisions of N.J.S.A. 19:44A-20.26. This law provides that 10 days prior to the award of such a contract, the contractor shall disclose contributions to:

- any continuing political committee (a.k.a., political action committee)
- any candidate committee of a candidate for, or holder of, an elective office:
    - of the public entity awarding the contract
    - of that county in which that public entity is located
    - of another public entity within that county
    - or of a legislative district in which that public entity is located or, when the public entity is a county, of any legislative district which includes all or part of the county

The disclosure must list reportable contributions to any of the committees that exceed $200 per election cycle that were made during the 12 months prior to award of the contract. See N.J.S.A. 19:44A-8 and 19:44A-16 for more details on reportable contributions.

N.J.S.A. 19:44A-20.26 itemizes the parties from whom contributions must be disclosed when a business entity is not a natural person. This includes the following:

- individuals with an "interest" ownership or control of more than 10% of the profits or assets of a business entity or 10% of the stock in the case of a business entity that is a corporation for profit
- all principals, partners, officers, or directors of the business entity or their spouses
- any subsidiaries directly or indirectly controlled by the business entity
- IRS Code Section 527 New Jersey based organizations, directly or indirectly controlled by the business entity and filing as continuing political committees, (PACs).

When the business entity is a natural person, "a contribution by that person's spouse or child, residing therewith, shall be deemed to be a contribution by the business entity." [N.J.S.A. 19:44A-20.26(b)] The contributor must be listed on the disclosure.

Any business entity that fails to comply with the disclosure provisions shall be subject to a fine imposed by ELEC in an amount to be determined by the Commission which may be based upon the amount that the business entity failed to report.

The enclosed list of agencies is provided to assist the contractor in identifying those public agencies whose elected official and/or candidate campaign committees are affected by the disclosure requirement. It is the contractor's responsibility to identify the specific committees to which contributions may have been made and need to be disclosed. The disclosed information may exceed the minimum requirement.

The enclosed form, a content-consistent facsimile, or an electronic data file containing the required details (along with a signed cover sheet) may be used as the contractor's submission and is disclosable to the public under the Open Public Records Act.

The contractor must also complete the attached Ownership Disclosure Certification. This will assist the agency in meeting its obligations under the law. **NOTE: This section does not apply to Board of Education contracts.**

C. 271 POLITICAL CONTRIBUTION DISCLOSURE FORM

Required Pursuant To N.J.S.A. 19:44A-20.26

This form or its permitted facsimile must be submitted to the local unit no later than 10 days prior to the award of the contract.

Part I – Vendor Information

Vendor Name:			
Address:			
City:		State:	Zip:

The undersigned being authorized to certify, hereby certifies that the submission provided herein represents compliance with the provisions of N.J.S.A. 19:44A-20.26 and as represented by the Instructions accompanying this form.

Signature	Printed Name	Title

Part II – Contribution Disclosure

Disclosure requirement: Pursuant to N.J.S.A. 19:44A-20.26 this disclosure must include all reportable political contributions (more than $200 per election cycle) over the 12 months prior to submission to the committees of the government entities listed on the form provided by the local unit.

☐ Check here if disclosure is provided in electronic form.

Contributor Name	Recipient Name	Date	Dollar Amount
			$

☐ Check here if the information is continued on subsequent page(s)

List of Agencies with Elected Officials Required for Political Contribution Disclosure
N.J.S.A. 19:44A-20.26

County Name: Mercer

State: Governor, and Legislative Leadership Committees

Legislative District #s: 12, 14, 15, & 30

State Senator and two members of the General Assembly per district.

County:

Freeholders	County Clerk	Sheriff
County Executive	Surrogate	

Municipalities (Mayor and members of governing body, regardless of title):

East Windsor Township	Hopewell Township	Trenton City
Ewing Township	Lawrence Township	Washington Township
Hamilton Township	Pennington Borough	West Windsor Township
Hightstown Borough	Princeton Borough	
Hopewell Borough	Princeton Township	

Boards of Education (Members of the Board):

East Windsor Regional	Hopewell Valley Regional	Washington Township
Ewing Township	Lawrence Township	West Windsor-Plainsboro Regional
Hamilton Township	Princeton Regional	

Fire Districts (Board of Fire Commissioners):

Chesterfield-Hamilton Fire District No. 1	Hamilton Township Fire District No. 9
Hamilton Township Fire District No. 2	Hopewell Borough Fire District No. 1
Hamilton Township Fire District No. 3	Hopewell Township Fire District No. 1
Hamilton Township Fire District No. 4	Hopewell Township Fire District No. 2
Hamilton Township Fire District No. 5	Hopewell Township Fire District No. 3
Hamilton Township Fire District No. 6	Pennington Borough Fire District No. 1
Hamilton Township Fire District No. 7	Washington Township Fire District No. 1
Hamilton Township Fire District No. 8	

Prohibited Russia-Belarus Activities & Iran Investment Activities

Person or Entity	

Part 1: Certification

COMPLETE PART 1 BY CHECKING **ONE OF THE THREE BOXES BELOW**

Pursuant to law, any person or entity that is a successful bidder or proposer, or otherwise proposes to enter into or renew a contract, for goods or services must complete the certification below prior to contract award to attest, under penalty of perjury, that neither the person or entity, nor any parent entity, subsidiary, or affiliate, is identified on the Department of Treasury's Russia-Belarus list or Chapter 25 list as a person or entity engaging in prohibited activities in Russia, Belarus or Iran. Before a contract for goods or services can be amended or extended, a person or entity must certify that neither the person or entity, nor any parent entity, subsidiary, or affiliate, is identified on the Department of Treasury's Russia-Belarus list. Both lists are found on Treasury's website at the following web addresses:

https://www.nj.gov/treasury/administration/pdf/RussiaBelarusEntityList.pdf
www.state.nj.us/treasury/purchase/pdf/Chapter25List.pdf.

As applicable to the type of contract, the above-referenced lists must be reviewed prior to completing the below certification.

A person or entity unable to make the certification must provide a detailed, accurate, and precise description of the activities of the person or entity, or of a parent entity, subsidiary, or affiliate, engaging in prohibited activities in Russia or Belarus and/or investment activities in Iran. The person or entity must cease engaging in any prohibited activities and provide an updated certification before the contract can be entered into.

If a vendor or contractor is found to be in violation of law, action may be taken as appropriate and as may be provided by law, rule, or contract, including but not limited to imposing sanctions, seeking compliance, recovering damages, declaring the party in default, and seeking debarment or suspension of the party.

CONTRACT AWARDS AND RENEWALS

☐	*I certify, pursuant to law, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate appears on the N.J. Department of Treasury's lists of entities engaged in prohibited activities in Russia or Belarus pursuant to P.L. 2022, c. 3 or in investment activities in Iran pursuant to P.L. 2012, c. 25 ("Chapter 25 List"). I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf.* (Skip Part 2 and sign and complete the Certification below.)

CONTRACT AMENDMENTS AND EXTENSIONS	
☐	*I certify, pursuant to law, that neither the person or entity listed above, nor any parent entity, subsidiary, or affiliate is listed on the N.J. Department of the Treasury's lists of entities determined to be engaged in prohibited activities in Russia or Belarus pursuant to P.L. 2022, c. 3. I further certify that I am the person listed above, or I am an officer or representative of the entity listed above and am authorized to make this certification on its behalf.* (Skip Part 2 and sign and complete the Certification below.)
IF UNABLE TO CERTIFY	
☐	*I am unable to certify as above because the person or entity and/or a parent entity, subsidiary, or affiliate is listed on the Department's Russia-Belarus list and/or Chapter 25 Iran list. I will provide a detailed, accurate, and precise description of the activities as directed in Part 2 below, and sign and complete the Certification below. Failure to provide such will prevent the award of the contract to the person or entity, and appropriate penalties, fines, and/or sanctions will be assessed as provided by law.*

Part 2: Additional Information

PLEASE PROVIDE FURTHER INFORMATION RELATED TO PROHIBITED ACTIVITIES IN RUSSIA OR BELARUS AND/OR INVESTMENT ACTIVITIES IN IRAN.

You must provide a detailed, accurate, and precise description of the activities of the person or entity, or of a parent entity, subsidiary, or affiliate, engaging in prohibited activities in Russia or Belarus and/or investment activities in Iran in the space below and, if needed, on additional sheets provided by you.

Part 3: Certification of True and Complete Information

I, being duly sworn upon my oath, hereby represent and state that the foregoing information and any attachments there, to the best of my knowledge, are true and complete. I attest that I am authorized to execute this certification on behalf of the above-referenced person or entity.

I acknowledge that the Contracting Unit is relying on the information contained herein and hereby acknowledge that I am under a continuing obligation from the date of this certification through the completion of any contracts with the Contracting Unit to notify the Contracting Unit in writing of any changes to the answers of information contained herein.

I acknowledge 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 recognize that I am subject to criminal prosecution under the law and that it will also constitute a material breach of my agreement(s) with the Contracting Unit and that the Contracting Unit at its option may declare any contract(s) resulting from this certification void and unenforceable.

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

STATUS OF PRESENT CONTRACTS

PURSUANT TO N.J.A.C. 17:19-2.13, BIDDER DECLARES THE FOLLOWING WITH RESPECT TO ITS UNCOMPLETED CONTRACTS, ON ALL WORK, FROM WHATEVER SOURCE (PUBLIC AND PRIVATE), BOTH IN NEW JERSEY AND FROM OTHER GOVERNMENTAL JURISDICTIONS.

- **Each classified bidder's aggregate rating shall be calculated in accordance with formula prescribed by N.J.A.C. 17:19-2.8.**
- **Calculations shall be based on Bidder's base bid amount only at time of bid or total amount of base bid and accepted Alternate Bids at time of Award.**

Entity	Project Title	Original Contract Amount	Uncompleted Amount As of Bid Opening Date	Name and Telephone Number of Party To Be Contacted From Entity For Verification

Sworn and Subscribed to before me
this_____day of_____, 20___

BIDDER

_____
Notary Public

_____
(Print and Signature)

PERFORMANCE RECORD

1. How many years has your organization been in business as a Contractor under your present business name? _____

2. How many years experience in construction work has your organization had:
(a) As a Prime contractor?_____(b) As a subcontractor? _____

3. What is the construction experience of the relevant principal individuals managing your organization and directly responsible at your organization?

Individual's Name	Present Position or Office	Years of Constr. Experience	Magnitude and Type of Work	In What Capacity

4. Have you ever failed to complete any work contracted to you? _____

   If so, where and why? _____
   _____
   _____

5. Has any officer or partner of your organization ever failed to complete a construction contract handled in its own name? _____

   If so, state name of individual, name of owner, location and type of project and reason for the failure to complete.
   _____
   _____
   _____

Continued

PERFORMANCE RECORD
(Continued)

List of all contracts completed by you.

Name of Owner	Name & Location of Project/ Type of Work	Prime or Sub-Contractor	Architect or Engineer in Charge for Owner	Contract Price (Omit Cost)	Date Completed	Was* Time Extension Necessary	Were any Penalties Imposed	Were* Liens Claims or Stop Notice Filed

*Explain "Yes" answers.

Continued

PERFORMANCE RECORD
CERTIFICATION

6. Explanation of details in connection with non-completion of contracts, time extensions, penalties imposed, labor troubles experience, liens, termination of contracts, poor performance, debarment, claims and notices filed against contracts.

_____
_____
_____
_____
_____

7. Within the last five years, please list active and settled litigation with public entities for all contractors, as well as the description and outcome (i.e. settlements).

_____
_____
_____
_____

8. Within the last five years, what percentage of the allowances have been used? _____

9. Within the last five years, how many times has the project allowance been exceeded _____ and by what percentage? _____

10. Are the owners/principals of the company, owners/principals of other companies? _____

    If yes, indicate name and address of Companies:

_____
_____
_____
_____
_____

11. The information above is true and complete to the best of my knowledge and belief.

_____
(Name of Organization)

_____
(Signature)

_____
(Title)

STATE OF)
)ss.
COUNTY OF)

_____, being duly sworn to law, deposes and says that it is authorized to make this affidavit for, and on behalf of, the individual, partnership or corporation herein first named as the Bidder, that deponent is familiar with the books of the said Bidder and that the foregoing statement is a true and accurate statement taken from the books of said Bidder of such financial

condition as of the date herein first named; that the answers to the foregoing interrogatories are true and correct.

Subscribed and sworn to before me

This_____day of_____, 20____

_____
(Signature)

_____
(Seal) Notary Public of New Jersey/
Specify Other State
My Commission Expires_____, 20____.

CERTIFICATION

CERTIFICATION OF INSURANCE STATEMENT

Project Title: _____

Project No.: _____

The Bidder fully understands the Owner's insurance requirements as stated in the Bid Documents and agrees to provide all insurance required by these documents at award of contract.

_____
COMPANY NAME

_____
BIDDER (Signature of Authorized Representative)

_____
BIDDER (Print Name of Authorized Representative)

Note: Failure to sign and submit this document prior to the Contract Award may result in the rejection of your Proposal.

CERTIFICATION OF INSURANCE STATEMENT

ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YY)
DATE ISSUED

PRODUCER:

Insured Insurance Broker/Agent Co.
Address
City, State, Zip Code
Fax #
Telephone #

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED

Your Company's Name
Address
City, State, Zip Code

INSURERS AFFORDING COVERAGE	**NAIC #**
INSURER A: **(A.M. Best Rated A- or better)**	
INSURER B: **(A.M. Best Rated A- or better)**	
INSURER C: **(A.M. Best Rated A- or better)**	
INSURER D: **(A.M. Best Rated A- or better)**	
INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POICY PERIOD INDICATED. NOT WITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A	GENERAL LIABILITY ☑ Commercial General Liability ☐ Claims Made ☑ Occur ☐ _____ Gen'l Aggregate Limit Applies ☐ Policy ☐ Project ☐ Loc	**Policy Number**	**MM/DD/YY**	**MM/DD/YY**	Ea. Occurrence	***$5,000,000***
					Fire Damage (any one Fire)	***$500,000***
					Med Exp (Any one person)	***$15,000***
					Personal & Adv Injury	***$1,000,000***
					General Aggregate	***$3,000,000***
					Products - Comp/Op Agg	***$1,000,000***
B	AUTOMOBILE LIABILITY ☑ Any Auto ☑ All owned Autos ☑ Scheduled Autos ☑ Hired Autos ☑ Non-Owned Autos ☐ _____ ☐ _____	**Policy Number**	**MM/DD/YY**	**MM/DD/YY**	Combined Single Limit (Ea Accident)	***$1,000,000***
					Bodily Injury (Per Person)	$
					Bodily Injury (Per Accident)	$
					Property Damage (Per Accident)	$
	GARAGE LIABILITY ☐ Any Auto ☐ _____				Auto Only-Ea Accident	
					Other than Auto Only: Ea Acc	$
					Agg	$
C	EXCESS/UMBRELLA LIABILITY ☑ Occur ☐ Claims Made ☐ Deductible ☐ Retention $_____	**Policy Number**	**MM/DD/YY**	**MM/DD/YY**	Each Occurrence	***$5,000,000***
					Aggregate	***$5,000,000***
					applicable if underlying limits are less than required	
D	Workers Compensation and Employer's Liability	**Policy Number**	**MM/DD/YY**	**MM/DD/YY**	☑ WC Statutory Limits ☐ Other	
					E.L. Each Accident	***$1,000,000***
					E.L. Disease - Ea Employee	***$1,000,000***
					E.L. Disease - Policy Limit	***$1,000,000***
	Other					

DESCRIPTION OF OPERATIONS/**LOCATIONS**/VEHICLES EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

The following are named as additonal insureds the Owner, CM, Architect and their Consultants Agents and Employees.

CERTIFICATE HOLDER

OWNER
Street Address
City, State, Zip Code

Additional Insured; Insurer Letter:

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT.

Authorized Representative

Signature

SAMPLE

EXHIBIT B
MANDATORY EQUAL EMPLOYMENT OPPORTUNITY LANGUAGE
N.J.S.A. 10:5-31 et seq. (P.L.1975, c.127)
N.J.A.C. 17:27-1.1 et seq.
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 affection 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 American 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.

EXHIBIT B (Continued)

(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:

1) 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. 17:27-5.3, 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 contractor 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 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 ration 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 website, 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.

(Revised: January, 2016)

Reviewed By:_____ Title: _____

Company:_____ Date: _____

Signature: _____

AMERICANS WITH DISABILITIES ACT OF 1990

Equal Opportunity for Individuals with Disability

The contractor and the Board of Education (hereafter "owner") do hereby agree that the provisions of Title 11 of the Americans With Disabilities Act of 1990 (the "Act")
(42 U.S.C. S121 01 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 owner 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 owner in any action or administrative proceeding commenced pursuant to this Act. The contractor shall indemnify, protect, and save harmless the owner, 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 owner's grievance procedure, the contractor agrees to abide by any decision of the owner which is rendered pursuant to said grievance procedure. If any action or administrative proceeding results in an award of damages against the owner, or if the owner 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 owner 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 owner or any of its agents, servants, and employees, the *owner shall* expeditiously forward or have forwarded to the contractor every demand, complaint, notice, summons, pleading, or other process received by the owner or its representatives. It is expressly agreed and understood that any approval by the owner 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 owner pursuant to this paragraph.

It is further agreed and understood that the owner 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 owner from taking any other actions available to it under any other provisions of the Agreement or otherwise at law.

Name of Company_____

Authorized Agent_____

Title or Position _____

Signature_____ Date_____

To be completed, signed, and returned with Bid.

Form AA302
Rev. 02/22

STATE OF NEW JERSEY

Division of Purchase & Property
Contract Compliance Audit Unit
EEO Monitoring Program

EMPLOYEE INFORMATION REPORT

IMPORTANT-READ INSTRUCTIONS CAREFULLY BEFORE COMPLETING FORM. FAILURE TO PROPERLY COMPLETE THE ENTIRE FORM AND TO SUBMIT THE REQUIRED $150.00 FEE MAY DELAY ISSUANCE OF YOUR CERTIFICATE. DO NOT SUBMIT EEO-1 REPORT FOR SECTION B, ITEM 11. For Instructions on completing the form, go to: https://www.nj.gov/treasury/contract_compliance/documents/pdf/forms/aa302ins.pdf

SECTION A - COMPANY IDENTIFICATION

1. FID. NO. OR SOCIAL SECURITY	2. TYPE OF BUSINESS ☐ 1. MFG ☐ 2. SERVICE ☐ 3. WHOLESALE ☐ 4. RETAIL ☐ 5. OTHER	3. TOTAL NO. EMPLOYEES IN THE ENTIRE COMPANY

4. COMPANY NAME — COMPANY E-MAIL

5. STREET — CITY — COUNTY — STATE — ZIP CODE

6. NAME OF PARENT OR AFFILIATED COMPANY (IF NONE, SO INDICATE) — CITY — STATE — ZIP CODE

7. CHECK ONE: IS THE COMPANY: ☐ SINGLE-ESTABLISHMENT EMPLOYER ☐ MULTI-ESTABLISHMENT EMPLOYER

8. IF MULTI-ESTABLISHMENT EMPLOYER, STATE THE NUMBER OF ESTABLISHMENTS IN NJ

9. TOTAL NUMBER OF EMPLOYEES AT ESTABLISHMENT WHICH HAS BEEN AWARDED THE CONTRACT

10. PUBLIC AGENCY AWARDING CONTRACT — CITY — COUNTY — STATE — ZIP CODE

Official Use Only	DATE RECEIVED	INAUG.DATE	ASSIGNED CERTIFICATION NUMBER

SECTION B - EMPLOYMENT DATA

11. Report all permanent, temporary and part-time employees ON YOUR OWN PAYROLL. Enter the appropriate figures on all lines and in all columns. Where there are no employees in a particular category, enter a zero. Include ALL employees, not just those in minority/non-minority categories, in columns 1, 2, & 3. *DO NOT SUBMIT AN EEO-1 REPORT.*

JOB CATEGORIES	ALL EMPLOYEES	PERMANENT MINORITY/NON-MINORITY EMPLOYEE BREAKDOWN													
	COL. 1	COL. 2	COL. 3	********* MALE*********						********* FEMALE*********					
	Total	Male	Female												
	(Cols.2 &3)			BLACK	HISPANIC	AMER INDIAN	ASIAN	NON MIN	2 OR MORE RACES	BLACK	HISPANIC	AMER INDIAN	ASIAN	NON MIN	2 OR MORE RACES
Officials/ Managers															
Professionals															
Technicians															
Sales Workers															
Office & Clerical															
Craftworkers (Skilled)															
Operatives (Semi-skilled)															
Laborers (Unskilled)															
Service Workers															
TOTAL															
Total employment From previous Report (if any)															
	The data below shall NOT be included in the figures for the appropriate categories above.														
Temporary & Part-Time Employees															

12. HOW WAS INFORMATION AS TO RACE OR ETHNIC GROUP IN SECTION B OBTAINED?
☐ 1. Visual Survey ☐ 2. Employment Record ☐ 3. Other (Specify)

13. DATES OF PAYROLL PERIOD USED
From: To:

14. IS THIS THE FIRST Employee Information Report Submitted?
1. YES ☐ 2. NO ☐

15. IF NO, DATE LAST REPORT SUBMITTED
MO. | DAY | YEAR

SECTION C - SIGNATURE AND IDENTIFICATION

16. NAME OF PERSON COMPLETING FORM (Print or Type) — SIGNATURE — TITLE — DATE MO | DAY | YEAR

17. ADDRESS NO. & STREET — CITY — COUNTY — STATE — ZIP CODE — PHONE (AREA CODE, NO.,EXTENSION)

- -

INSTRUCTIONS FOR COMPLETING THE EMPLOYEE INFORMATION REPORT (FORM AA302)

IMPORTANT: READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE COMPLETING THE FORM. PRINT OR TYPE ALL INFORMATION. FAILURE TO PROPERLY COMPLETE THE ENTIRE FORM **AND TO SUBMIT THE REQUIRED $150.00 NON-REFUNDABLE FEE MAY DELAY ISSUANCE OF YOUR CERTIFICATE**. **IF YOU HAVE A CURRENT CERTIFICATE OF EMPLOYEE INFORMATION REPORT, DO NOT COMPLETE THIS FORM UNLESS YOUR ARE RENEWING A CERTIFICATE THAT IS DUE FOR EXPIRATION. DO NOT COMPLETE THIS FORM FOR CONSTRUCTION CONTRACT AWARDS.**

ITEM 1 - Enter the Federal Identification Number assigned by the Internal Revenue Service, or if a Federal Employer Identification Number has been applied for, or if your business is such that you have not or will not receive a Federal Employer Identification Number, enter the Social Security Number of the owner or of one partner, in the case of a partnership.

ITEM 2 - Check the box appropriate to your TYPE OF BUSINESS. If you are engaged in more than one type of business check the predominate one. If you are a manufacturer deriving more than 50% of your receipts from your own retail outlets, check "Retail".

ITEM 3 - Enter the total "number" of employees in the entire company, including part-time employees. This number shall include all facilities in the entire firm or corporation.

ITEM 4 - Enter the name by which the company is identified and the company email. If there is more than one company name, enter the predominate one.

ITEM 5 - Enter the physical location of the company. Include City, County, State and Zip Code.

ITEM 6 - Enter the name of any parent or affiliated company including the City, County, State and Zip Code. If there is none, so indicate by entering "None" or N/A.

ITEM 7 - Check the box appropriate to your type of company establishment. "Single-establishment Employer" shall include an employer whose business is conducted at only one physical location. "Multi-establishment Employer" shall include an employer whose business is conducted at more than one location.

ITEM 8 - If "Multi-establishment" was entered in item 8, enter the number of establishments within the State of New Jersey.

ITEM 9 - Enter the total number of employees at the establishment being awarded the contract.

ITEM 10 - Enter the name of the Public Agency awarding the contract. Include City, County, State and Zip Code. This is not applicable if you are renewing a current Certificate.

ITEM 11 - Enter the appropriate figures on all lines and in all columns. THIS SHALL ONLY INCLUDE EMPLOYMENT DATA FROM THE FACILITY THAT IS BEING AWARDED THE CONTRACT. DO NOT list the same employee in more than one job category. **DO NOT attach an EEO-1 Report**.

Racial/Ethnic Groups will be defined:
Black: Not of Hispanic origin. Persons having origin in any of the Black racial groups of Africa.
Hispanic: Persons of Mexican, Puerto Rican, Cuban, or Central or South American or other Spanish culture or origin, regardless of race.
American Indian or Alaskan Native: Persons having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.
Asian or Pacific Islander: Persons having origin in any of the original peoples of the Far East, Southeast Asia, the Indian Sub-continent or the Pacific Islands. This area includes for example, China, Japan, Korea, the Phillippine Islands and Samoa.
Non-Minority: Any Persons not identified in any of the aforementioned Racial/Ethnic Groups.
2 or More Races: Persons identifying as 2 or More Races.

ITEM 12 - Check the appropriate box. If the race or ethnic group information was not obtained by 1 or 2, specify by what other means this was done in 3.

ITEM 13 - Enter the dates of the payroll period used to prepare the employment data presented in Item 12.

ITEM 14 - If this is the first time an Employee Information Report has been submitted for this company, check block "Yes".

ITEM 15 - If the answer to Item 15 is "No", enter the date when the last Employee Information Report was submitted by this company.

ITEM 16 - Print or type the name of the person completing the form. Include the signature, title and date.

ITEM 17 - Enter the physical location where the form is being completed. Include City, State, Zip Code and Phone Number.

TYPE OR PRINT IN SHARP BALL POINT PEN

THE VENDOR IS TO COMPLETE THE EMPLOYEE INFORMATION REPORT FORM (AA302) AND RETAIN A COPY FOR THE VENDOR'S OWN FILES. THE VENDOR SHOULD ALSO SUBMIT A COPY TO THE PUBLIC AGENCY AWARDING THE CONTRACT IF THIS IS YOUR FIRST REPORT; AND FORWARD ONE COPY **WITH A CHECK IN THE AMOUNT OF $150.00 PAYABLE TO THE TREASURER, STATE OF NEW JERSEY(FEE IS NON-REFUNDABLE)** TO:

NJ Department of the Treasury
Division of Purchase & Property
Contract Compliance Audit Unit
EEO Monitoring Program
P.O. Box 206
Trenton, New Jersey 08625-0206 **Telephone No. (609) 292-5473**

AFFIRMATIVE ACTION COMPLIANCE NOTICE
N.J.S.A. 10:5-31 and N.J.A.C. 17:27

GOODS AND SERVICES CONTRACTS
(INCLUDING PROFESSIONAL SERVICES)

This form is a summary of the successful bidder's requirement to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27-1 et seq.

The successful bidder shall submit to the public agency, after notification of award but prior to execution of this contract, one of the following three documents as forms of evidence:

(a) A photocopy of a valid letter that the contractor is operating under an existing Federally approved or sanctioned affirmative action program (good for one year from the date of the letter);

OR

(b) A photocopy of a Certificate of Employee Information Report approval, issued in accordance with N.J.A.C. 17:27-4;

OR

(c) A photocopy of an Employee Information Report (Form AA302) provided by the Division and distributed to the public agency to be completed by the contractor in accordance with N.J.A.C. 17:27-4.

The successful vendor may obtain the Affirmative Action Employee Information Report (AA302) from the contracting unit during normal business hours.

The successful vendor(s) must submit the copies of the AA302 Report to the Division of Contract Compliance and Equal Employment Opportunity in Public Contracts (Division). The Public Agency copy is submitted to the public agency, and the vendor copy is retained by the vendor.

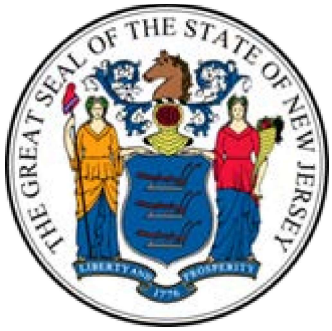
The undersigned vendor certifies that he/she is aware of the commitment to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27.1 et seq. and agrees to furnish the required forms of evidence.

The undersigned vendor further understands that his/her bid shall be rejected as non-responsive if said contractor fails to comply with the requirements of N.J.S.A. 10:5-31 and N.J.A.C. 17:27-1 et seq.

COMPANY: _____ SIGNATURE: _____

PRINT NAME: _____ TITLE: _____

DATE: _____



FREQUENTLY ASKED QUESTIONS

WEBSITE TO OBTAIN FORMS: www.state.nj.us/treasury/contract_compliance

WHO SHOULD CHECK OR MONEY ORDER BE PAYABLE TO? The Treasurer, State of New Jersey

HOW TO OBTAIN A DUPLICATE CERTIFICATE: Visit the website above and select forms. Print and complete the Duplicate Request Form and mail with a $75 check or money order payable to The Treasurer, State of NJ, PO Box 206, Trenton, NJ 08625. **NOTE**: No fee is required for name and/or address updates.

HOW LONG DOES IT TAKE TO PROCESS FORM AA-302 AND RECEIVE CERTIFICATE OF EMPLOYEE INFORMATION REPORT? The initial Form AA-302 certificate may take up to three (3) weeks. Renewals certificates may take up to two (2) weeks.

HOW LONG ARE CERTIFICATES VALID? For entities with fewer than 50 employees, the certificate is valid for seven (7) years. For entities with 50 employees or more, the certificate is valid for three (3) years.

WHICH ADDRESS SHOULD BE USED? When using the United States Postal Service (regular mail) to deliver the Form AA-302 and payment, the following address must be used:

NJ Dept. of the Treasury
Contract Compliance and Audit Unit
EEO Monitoring Program
PO Box 206
Trenton, NJ 08625-0206

When using a commercial delivery service such as FEDEX, UPS or other delivery service, the following address must be used:

NJ Dept. of the Treasury
Contract Compliance and Audit Unit
EEO Monitoring Program
33 West State Street, 9th floor
Trenton, NJ 08625

FOR QUESTIONS RELATED TO CONSTRUCTION FORMS AA-201 AND AA-202: Contact the NJ Dept. of Labor and Workforce Development, Office of Diversity and Compliance, Construction EEO Monitoring Program at (609) 292-9550.

HOW TO REGISTER FOR SUBMISSION OF ELECTRONIC RENEWAL CERTIFICATE: Visit www.state.nj.us/treasury/contract_compliance. Select the Premier Business Services Online Forms Account Instructions and follow the instructions.

HOW TO SUBMIT PAYMENT AFTER FILING RENEWAL CERTIFICATE ELECTRONICALLY? Mail check or money order (in the amount of $150) to the Division along with a print out of the online submission screen. Make check or money order payable to: The Treasurer, State of New Jersey. Please write your certificate number on the check or money order.

RECEIVED RENEWAL NOTICE – HOW DO I RENEW MY CERTIFICATE? Follow the instructions on the renewal notice, refer to the Division's website and select forms, print out the renewal package, complete Form AA-302, Vendor Activity Summary Reports and mail in along with a check or money order payable to: The Treasurer, State of New Jersey.

TO OBTAIN THE STATUS OF YOUR CERTIFICATE: Please call (609) 292-5473 and a representative will be available to assist you. Please have your federal ID or certificate number available to ensure faster service. **NOTE**: Renewal Notices will be mailed within 90 days prior to the expiration date of your certificate.

CAN PAYMENTS BE MADE WITH CREDIT CARDS? Payments are only accepted in the form of a check or money order in the amount of $150 and must be submitted with the Form AA-302 (Employee Information Report).

DO NONPROFIT ORGANIZATIONS HAVE TO COMPLETE FORM AA-302? Yes, the Employee Information Report (Form AA-302) must be completed by nonprofit organizations to ensure compliance with the EEO requirements.

WHAT DOES THE CERTIFICATE LOOK LIKE? The Certificate of Employee Information Report is yellow in color, 3 ½ X 8 ½ and has your assigned certificate number in the top right corner. The entity's name and address along with the effective date and expiration date also are included on the certificate.

THE COMPANY HAS NO EMPLOYEES. SHOULD THE OWNER OPERATING THE BUSINESS REPORT NO EMPLOYEES OR ONE EMPLOYEE FOR HIMSELF/HERSELF? A company with no employees must report the officials and managers on line #3 and also on line #11 (officials/managers).

SAMPLE CERTIFICATE OF EMPLOYEE INFORMATION REPORT

Certification 111XX

CERTIFICATE OF EMPLOYEE INFORMATION REPORT

INITIAL

This is to certify that the contractor listed below has submitted an Employee Information Report pursuant to N.J.A.C. 17:27-1.1 et. seq. and the State Treasurer has approved said report. This approval will remain in effect for the period of 15-DEC-20XX to 15-DEC-20XX

SAMPLE COMPANY, INC.
33 WEST STATE STREET
TRENTON, NJ 08625

VOID

State Treasurer

INSTRUCTIONS FOR COMPLETING THE INITIAL PROJECT WORKFORCE REPORT – CONSTRUCTION (AA201)

DO NOT COMPLETE THIS FORM FOR GOODS AND/OR SERVICE CONTRACTS

1. **Enter the Federal Identification Number assigned to the contractor by the Internal Revenue Service, or if a Federal Employer Identification Number has been applied for but not yet issued, or if your business is such that you have not or will not receive a Federal Identification Number, enter the social security number assigned to the single owner or one partner, in the case of a partnership.**

2. **Note: The Department of Labor & Workforce Development, Construction EEO Monitoring Program will assign a contractor ID number to your company. This number will be your permanently assigned contractor ID number that must be on all correspondence and reports submitted to this office.**

3. **Enter the prime contractor's name, address and zip code number.**

4. **Check box if Company is Minority Owned or Woman Owned**

5. **Enter the complete name and address of the Public Agency awarding the contract. Include the contract number, date of award and dollar amount of the contract.**

6. **Enter the name and address of the project, including the county in which the project is located.**

7. **Note: A project contract ID number will be assigned to your firm upon receipt of the completed Initial Project Workforce Report (AA201) for this contract. This number must be indicated on all correspondence and reports submitted to this office relating to this contract.**

8. **Check "Yes" or "No" to indicate whether a Project Labor Agreement (PLA) was established with the labor organization(s) for this project.**

9. **Under the Projected Total Number of Employees in each trade or craft and at each level of classification, enter the total composite workforce of the prime contractor and all subcontractors projected to work on the project. Under Projected Employees enter total minority and female employees of the prime contractor and all subcontractors projected to work on the project. Minority employees include Black, Hispanic, American Indian and Asian, (J=Journeyworker, AP=Apprentice). Include projected phase-in and completion dates.**

10. **Print or type the name of the company official or authorized Equal Employment Opportunity (EEO) official include signature and title, phone number and date the report is submitted.**

This report must be submitted to the Public Agency that awards the contract and the Department of Labor & Workforce Development, Construction EEO Compliance Monitoring Program after notification of award, but prior signing the contract.

THE CONTRACTOR IS TO RETAIN A COPY AND SUBMIT COPY TO THE PUBLIC AGENCY AWARDING THE CONTRACT AND FORWARD A COPY TO:

NEW JERSEY DEPARTMENT OF LABOR & WORKFORCE DEVELOPMENT
CONSTRUCTION EEO COMPLIANCE MONITORING UNIT
P.O. BOX 209
TRENTON, NJ 08625-0209
(609) 292-9550

STATE OF NEW JERSEY

DEPARTMENT OF LABOR & WORKFORCE DEVELOPMENT
CONSTRUCTION EEO COMPLIANCE MONITORING PROGRAM

FORM AA-201
Revised 11/11

INITIAL PROJECT WORKFORCE REPORT CONSTRUCTION

Official Use Only

Assignment

Code

For instructions on completing the form, go to: http://www.state.nj.us/treasury/contract_compliance/pdf/aa201ins.pdf

1. FID NUMBER

2. CONTRACTOR ID NUMBER

3. NAME AND ADDRESS OF PRIME CONTRACTOR

(Name)

(Street Address)

(City) **(State)** **(Zip Code)**

4. IS THIS COMPANY MINORITY OWNED [ ] OR WOMAN OWNED [ ]

5. NAME AND ADDRESS OF PUBLIC AGENCY AWARDING CONTRACT

Name:
Address:

CONTRACT NUMBER **DATE OF AWARD** **DOLLAR AMOUNT OF AWARD**

6. NAME AND ADDRESS OF PROJECT

Name:
Address:

COUNTY

7. PROJECT NUMBER

8. IS THIS PROJECT COVERED BY A PROJEC
LABOR AGREEMENT (PLA)? YES

9. TRADE OR CRAFT	PROJECTED TOTAL EMPLOYEES				PROJECTED MINORITY EMPLOYEES				**PROJECTED PHASE - IN DATE**	**PROJECTED COMPLETION DATE**
	MALE		FEMALE		MALE		FEMALE			
	J	AP	J	**AP**	J	AP	J	AP		
1. ASBESTOS WORKER										
2. BRICKLAYER OR MASON										
3. CARPENTER										
4. ELECTRICIAN										
5. GLAZIER										
6. HVAC MECHANIC										
7. IRONWORKER										
8. OPERATING ENGINEER										
9. PAINTER										
10. PLUMBER										
11. ROOFER										
12. SHEET METAL WORKER										
13. SPRINKLER FITTER										
14. STEAMFITTER										
15. SURVEYOR										
16. TILER										
17. TRUCK DRIVER										
18. LABORER										
19. OTHER										
20. OTHER										

I hereby certify that the foregoing statements made by me are true. I am aware that if any of the foregoing statements are willfully false, I am subject to punishment.

(Signature)

10. **(Please Print Your Name)** **(Title)**

(Area Code) **(Telephone Number)** **(Ext.)** **(Date)**

FORM AA-202
REVISED 11/11

State Of New Jersey

Department of Labor & Workforce Development
Construction EEO Compliance Monitoring Program

MONTHLY PROJECT WORKFORCE REPORT - CONSTRUCTION

For instructions on completing the form, go to:
http://www.state.nj.us/treasury/contract_compliance/pdf/aa202ins.pdf

3. F ID or SS Number

1.Name and address of Prime Contractor

2. Contractor ID Number

4. Reporting Period

(NAME)

5. Public Agency Awarding Contract **Date of Award**

(ADDRESS)

6. Name and Location of Project **County**

7. Project ID Number

(CITY) (STATE) (ZIP CODE)

8. CONTRACTOR NAME (LIST PRIME CONTRACTOR WITH SUBS FOLLOWING)	9. PERCENT OF WORK COMPLETED	10. TRADE OR CRAFT	CLASSIFICATION (SEE REVERSE)	11. NUMBER OF EMPLOYEES A. TOTAL	B. BLACK	C. HISPANIC	D. AMERICAN INDIAN	E. ASIAN	F. FEMALES	12. TOTAL NO. OF MIN. EMP.	13. WORK HOURS TOTAL WORK HOURS	A. MIN. W/H	B. FEMALE W/H	14. % OF WORK HRS A. % OF MIN. W/H	B. % OF FEMALE W/H	15. CUM. WORK HRS TOTAL WORK HOURS	A. MIN. HOURS	B. FEMALE HOURS	16. CUM. % OF W/H A. % OF MIN. W/H	B. % OF FEM. W/H
			J																	
			AP																	
			J																	
			AP																	
			J																	
			AP																	
			J																	
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			J																	
			AP																	

17. COMPLETED BY (PRINT OR TYPE)

(NAME) (SIGNATURE) (TITLE)

(AREA CODE) (TELEPHONE NUMBER) (EXT.) (DATE)

Sample Performance Bond

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned _____, as Principal, and _____ SURETY COMPANY, a corporation of the State of _____duly authorized to do business in the State of New Jersey, having an office at _____, are hereby held and firmly bound unto the _____ in the penal sum of _____ Dollars, for payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this _____ day of _____, 20_____.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, the above named Principal did on the _____ day _____, 20_____ enter into a written contract with the _____for _____
which said contract is made a part of this bond as set forth herein.

NOW, if the said _____ shall well and faithfully do and perform the things agreed by _____ _____ to be done and performed according to the terms of the said contract, and shall 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, we agreeing and assenting that this undertaking shall be for the benefit of any beneficiary as defined in N.J.S.A. 2A:44-143 having a just claim, as well as for the obligee herein; then this obligation shall be void, otherwise the same shall remain in full 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 penal amount of this obligation as herein stated.

The said surety hereby stipulated and agrees that no modifications, omissions or additions in or to the terms of the said contract, or in or to the plans or specifications therefore shall in any way effect the obligation of said surety on its bond.

This bond is given in compliance with the requirements of the statutes of the State of New Jersey in respect to bonds on contractors on public works. Revised Statutes of New Jersey, 1937, Sections 2A:44-143 to 147, and amendments thereof, and liability hereunder is limited as in said statutes provided.

_____ _____
Witness Principal

_____ _____
Witness as to Surety

Surety Disclosure Statement and Certification
N.J.S. A. 2A:44-143
SAMPLE

SURETY DISCLOSURE STATEMENT AND CERTIFICATION
....., surety(ies) on the attached bond, hereby certifies(y) the following:

(1) The surety meets the applicable capital and surplus requirements of R.S.17:17-6 or R.S.17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital (where applicable) and surplus, as determined in accordance with the applicable laws of this State, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ended December 31, ... (most recent calendar year for which capital and surplus amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety's capital and surplus amounts, together with the name and address of the firm of certified public accounts that shall have certified those amounts): ....

(3) (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each such surety that surety's underwriting limitation and the effective date thereof): ....

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to R.S.17:18-9 as of (date on which such limitation was so established) is as follows (indicating for each such surety that surety's underwriting limitation and the date on which that limitation was established): ....

(4) The amount of the bond to which this statement and certification is attached is $ .....

(5) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3)(a) or (3)(b) above, or both, then for each such contract of reinsurance:

(a) The name and address of each such reinsurer under that contract and the amount of that reinsurer's participation in the contract is as follows:..... ....; and

(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under P.L.1993, c.243 (C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

CERTIFICATE

(to be completed by an authorized certifying agent for each surety on the bond)

I ..... (name of agent), as ..... (title of agent) for ..... (name of surety), a corporation/mutual insurance company/other (indicating type of business organization) (circle one) domiciled in ..... (state of domicile), DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOIDABLE.

.....
(Signature of certifying agent)

.....
(Printed name of certifying agent)

.....
(Title of certifying agent)

PAYMENT BOND

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned _____ as PRINCIPAL and sureties with underwriting office at _____ to which all communication in regard to this bond should be addressed, a Corporation organized and existing under the laws of the State of_____and duly authorized to do business in the state of New Jersey, as SURETY, are hereby held and firmly bound unto the _____ in the penal sum of _____, for payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

SIGNED and SEALED this_____day of_____two thousand and_____.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT, WHEREAS, the above named Principal did on the _____ day of _____, 20____, entered into a contract with _____ identified as _____ which said contract, upon execution by the Owner, and the Principal, will be a part of this bond the same as though set forth herein.

Now, if the said Principal shall pay all lawful claims of beneficiaries as defined by N.J.S.2A:44-143 for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils, implement or machinery furnished, used or consumed in carrying forward, performing or completing of said contract, we agreeing and assenting that this undertaking shall be for the benefit of any beneficiary as defined in N.J.S.2A;44-143 having a just claim, as well as for the party of the first part mentioned in the contract aforesaid; then this obligation shall be void; otherwise the same shall remain in full 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 penal amount of this obligation as herein stated.

The said Surety hereby stipulated and agrees that no modifications, omissions or additions in or to the terms of the said contract, or in or to the plans or specifications therefore, shall in anyway affect the obligations of said Surety on its bond.

Principal:

Affix Corporate Seal

_____
Witness

_____
Print or Type Name

By: _____
Print Name:
Print Title:

Surety:

Affix Corporate Seal

_____
Witness

_____
Print or Type Name

By: _____
Print Name:
Print Title:

Surety Disclosure Statement and Certification
N.J.S. A. 2A:44-143
SAMPLE

SURETY DISCLOSURE STATEMENT AND CERTIFICATION
....., surety(ies) on the attached bond, hereby certifies(y) the following:

(1) The surety meets the applicable capital and surplus requirements of R.S.17:17-6 or R.S.17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital (where applicable) and surplus, as determined in accordance with the applicable laws of this State, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ended December 31, ... (most recent calendar year for which capital and surplus amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety's capital and surplus amounts, together with the name and address of the firm of certified public accounts that shall have certified those amounts): ....

(3) (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each such surety that surety's underwriting limitation and the effective date thereof): ....

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to R.S.17:18-9 as of (date on which such limitation was so established) is as follows (indicating for each such surety that surety's underwriting limitation and the date on which that limitation was established): ....

(4) The amount of the bond to which this statement and certification is attached is $ .....

(5) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3)(a) or (3)(b) above, or both, then for each such contract of reinsurance:

(a) The name and address of each such reinsurer under that contract and the amount of that reinsurer's participation in the contract is as follows:..... ....; and

(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under P.L.1993, c.243 (C.17:51B-1 et seq.) and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

CERTIFICATE

(to be completed by an authorized certifying agent for each surety on the bond)

I ..... (name of agent), as ..... (title of agent) for ..... (name of surety), a corporation/mutual insurance company/other (indicating type of business organization) (circle one) domiciled in ..... (state of domicile), DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOIDABLE.

.....
(Signature of certifying agent)

.....
(Printed name of certifying agent)

.....
(Title of certifying agent)

MAINTENANCE BOND

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

_____

as principal, and _____ a Corporation organized and existing under the laws of the state of _____, and duly authorized to do business in the State of New Jersey, as Surety, are held and firmly bound unto the _____ as Owner, in the penal sum of _____

_____

(10% of the Final Contract Amount)

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 OF THE ABOVE OBLIGATION IS SUCH, That whereas the above named principal did on the _____ day of _____, 20___ , enter into a Contract with the Owner for_____

_____

_____

(Project Name)

which said Contract is made a part of this bond the same as though set forth herein.

NOW, if the said principal shall remedy without cost to the Owner any defects which may develop during the two (2) year Maintenance Period of the work performed under the said Contract, provided such defects, in the judgment of the Owner are caused by defective or inferior materials or workmanship, then this obligation shall be void, otherwise it shall be and remain in full force and effect. The two (2) year period shall commence on the date established in the Certificate of Substantial Completion.

The said Surety hereby stipulates and agrees that no modifications, deletions or additions in or to the terms of the said Contract or the plans or specifications therefor shall in any way affect its obligations on this bond.

Signed and Sealed this _____ day of _____, 20__.

_____
(Principal) (Seal)

_____
(Witness)

_____
(Title)

_____
(Surety) (Seal)

_____
(Witness)

_____
(Title)

Surety Disclosure Statement and Certification
N.J.S. A. 2A:44-143

SAMPLE

SURETY DISCLOSURE STATEMENT AND CERTIFICATION

....., surety(ies) on the attached bond, hereby certifies(y) the following:

(1) The surety meets the applicable capital and surplus requirements of N.J.S.A.17:17-6 or N.J.S.A. 17:17-7 as of the surety's most current annual filing with the New Jersey Department of Insurance.

(2) The capital (where applicable) and surplus, as determined in accordance with the applicable laws of this State, of the surety(ies) participating in the issuance of the attached bond is (are) in the following amount(s) as of the calendar year ended December 31, ... (most recent calendar year for which capital and surplus amounts are available), which amounts have been certified as indicated by certified public accountants (indicating separately for each surety that surety's capital and surplus amounts, together with the name and address of the firm of certified public accounts that shall have certified those amounts):

.....

.....

.....

(3) (a) With respect to each surety participating in the issuance of the attached bond that has received from the United States Secretary of the Treasury a certificate of authority pursuant to 31 U.S.C. 9305, the underwriting limitation established therein and the date as of which that limitation was effective is as follows (indicating for each such surety that surety's underwriting limitation and the effective date thereof):

.....

.....

.....

(b) With respect to each surety participating in the issuance of the attached bond that has not received such a certificate of authority from the United States Secretary of the Treasury, the underwriting limitation of that surety as established pursuant to N.J.S.A. 17:18-9 as of (date on which such limitation was so established) is as follows (indicating for each such surety that surety's underwriting limitation and the date on which that limitation was established):

.....

.....

.....

(4) The amount of the bond to which this statement and certification is attached is $.....

(5) If, by virtue of one or more contracts of reinsurance, the amount of the bond indicated under item (4) above exceeds the total underwriting limitation of all sureties on the bond as set forth in items (3)(a) or (3)(b) above, or both, then for each such contract of reinsurance:

(a) The name and address of each such reinsurer under that contract and the amount of that reinsurer's participation in the contract is as follows:.....

.....

.....

.....; and

(b) Each surety that is party to any such contract of reinsurance certifies that each reinsurer listed under item (5)(a) satisfies the credit for reinsurance requirement established under NJSA 17:51B-1 et seq. and any applicable regulations in effect as of the date on which the bond to which this statement and certification is attached shall have been filed with the appropriate public agency.

CERTIFICATE

(to be completed by an authorized certifying agent

for each surety on the bond)

I ..... (name of agent), as ..... (title of agent) for ..... (name of surety), a corporation/mutual insurance company/other (indicating type of business organization) (circle one) domiciled in ..... (state of domicile), DO HEREBY CERTIFY that, to the best of my knowledge, the foregoing statements made by me are true, and ACKNOWLEDGE that, if any of those statements are false, this bond is VOIDABLE.

.....

(Signature of certifying agent)

.....

(Printed name of certifying agent)

.....

(Title of certifying agent)

AIA® Document A132® – 2019

Standard Form of Agreement Between Owner and Contractor, *Construction Manager as Adviser Edition*

AGREEMENT made as of the day of in the year
(In words, indicate day, month, and year.)

BETWEEN the Owner:
(Name, legal status, address, and other information)

Princeton Public Schools
25 Valley Road
Princeton, NJ 08540

and the Contractor:
(Name, legal status, address, and other information)

for the following Project:
(Name, location, and detailed description)
Renovations to Princeton High School
151 Moore St., Princeton, NJ 08540

The Construction Manager:
(Name, legal status, address, and other information)
New Road Construction Management Company, Inc.
1876 Greentree Road, Cherry Hill, NJ 08003

The Architect:
(Name, legal status, address, and other information)

Fraytak Veisz Hopkins Duthie, P.C.
1515 Lower Ferry Road
Trenton, NJ 08618

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser. AIA Document A232™–2019 is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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9 ENUMERATION OF CONTRACT DOCUMENTS

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ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, Instructions to Bidders and the Bid Package, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than Modifications, appears in Article 9. In the event of any conflict among the Contract Documents, the Contractor shall notify the Owner and the Architect of same and follow and comply with their interpretation of same.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[**X**] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

(Paragraph deleted)

§ 3.3 Substantial Completion of the Project or Portions Thereof

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the date of Substantial Completion of the Work of all of the Contractors for the Project will be:

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(Insert the date of Substantial Completion of the Work of all Contractors for the Project.)

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of all of the Contractors for the Project are to be completed prior to Substantial Completion of the entire Work of all of the Contractors for the Project, the Contractors shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.4 When the Work of this Contract, or any Portion Thereof, is Substantially Complete

§ 3.4.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall substantially complete the entire Work of this Contract:
(Check one of the following boxes and complete the necessary information.)

[X] Not later than ( ) calendar days from the Notice to Proceed.

[ ] By the following date:

§ 3.4.1 If the number of days exceeds the number of days allowed in the specifications, a deduction from the contract price or any wages paid by the Board of Education to any inspectors necessarily employed by it on the work may be permitted by Owner. All deductions of wages shall be pursuant to the provisions contained in N.J.S.A. 18A:18A-19.

§ 3.4.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of this Contract are to be substantially complete prior to when the entire Work of this Contract shall be substantially complete, the Contractor shall substantially complete such portions by the following dates:

Portion of Work	Date to be substantially complete

§ 3.4.3 If the Contractor fails to substantially complete the Work of this Contract, or portions thereof, as provided in this Section 3.4, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:
(Check the appropriate box.)

[X] Stipulated Sum, in accordance with Section 4.2 below

[ ] Cost of the Work plus the Contractor's Fee, in accordance with Section 4.3 below

[ ] Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 4.4 below

(Based on the selection above, complete Section 4.2, 4.3 or 4.4 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Contract Sum shall be ($), subject to additions and deductions as provided in the Contract Documents.

§ 4.2.2 Alternates

§ 4.2.2.1 Alternates, if any, included in the Contract Sum: Section 01030 – Alternate Bids

Item	Price

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§ 4.2.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.2.3 Allowances, if any, included in the Contract Sum: Section 01020 - Allowances
(Identify each allowance.)

Item	Price

§ 4.2.4 Unit prices, if any: Section 01151 – Unit Prices
(Identify the item and state the unit price, and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

(Paragraphs deleted)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any, to be assessed in accordance with Section 3.4.)

Liquidated Damages to be assessed in accordance with the Specification requirements, Section 01800, entitled "Time of Completion and Liquidated Damages." By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work. TIME IS OF THE ESSENCE. If the Contractor fails to complete his work or fails to complete a portion of his work and therefore not achieve Substantial Completion and/or Final Completion on the respective dates required, s/he shall pay the Owner, as liquidated damages and not as a penalty, ($2,000) per day, which is agreed upon as a reasonable and proper measure which the Owner will sustain each calendar day by failure of the Contractor to complete work within the stipulated time. Substantial Completion and Final Completion liquidated damages shall be stacked and be concurrently imposed.

ARTICLE 5 PAYMENTS

§ 5.0 No billings shall be deemed approved and certified by passage of time unless submitted in accordance with the application date as specified in Section 5.1.3 above. Moreover, if the contractor materially fails to perform in accordance with the provisions of the contract, the remedies of the Prompt Payment Act will not be applied, and failure by the Owner to act within the time allowed by N.J.S.A. 2A:30A-1 *et seq*. , resulting from the contractor's significant failure to perform, shall not constitute an implied approval of the Payment Application.

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Construction Manager by the Contractor, and Certificates for Payment issued by the Construction Manager and Architect, the Owner shall make progress payments on account of the Contract Sum, to the Contractor, as provided below and elsewhere in the Contract Documents.

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§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows: Each Application for Payment must be accompanied by Certified Payroll Records for the period covered by the Application. The payroll records shall indicate the proper classification of employees and the payment of overtime, if any. These records shall include each Contractor's subcontractor's certified payroll. Payment will not be authorized if the required payroll records have not been submitted.

§ 5.1.3 Provided that an Application for Payment is received by the Construction Manager not later than the 25th day of a month, and provided the Application for Payment is approved, and the Owner thereafter approves the Application for Payment, the Owner shall make payment of the amount certified to the Contractor at the next scheduled public meeting of the Board of Education following the Owner's receipt of the Application for Payment. All payments made in accordance with the provisions herein shall comply with the New Jersey Prompt Payment Act.

§ 5.1.3 .1 The Owner will issue timely payments for those duly approved and undisputed to the contractor(s) in accordance with the requirements of the Prompt Payment Act, N.J.S.A. 2A:30A-1 et seq., as described in Section 00860.

§ 5.1.4 Progress Payments Where the Contract Sum is Based on a Stipulated Sum

§ 5.1.4.1 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Construction Manager and Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment. Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay. Moreover, if the contractor fail to perform in accordance with the provisions of the contract in a significant way, the remedies of the Prompt Payment Act will not be applied, and failure by the Owner to act within the time allowed by N.J.S.A. 2A:30A-1 et seq. shall not constitute an implied approval of the Payment Application.

§ 5.1.4.2 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment, which period shall be a calendar month in accordance with N.J.S.A. 40A:11-16.2. No billings shall be deemed approved and certified by passage of time unless submitted in accordance with the application date as specified in Section 5.1.3 above. Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 5.1.4.3 In accordance with AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.4.3.1 The amount of each progress payment shall first include:

- **.1** That portion of the Contract Sum properly allocable to completed Work;
- **.2** That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and for which releases of liens have been furnished; and
- **.3** That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.4.3.2 The amount of each progress payment shall then be reduced by:

- **.1** The aggregate of any amounts previously paid by the Owner;
- **.2** The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;
- **.3** Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

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.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019; and

.5 Retainage withheld pursuant to Section 5.1.7.

(Paragraphs deleted)

§ 5.1.5.6 Except with the Owner's prior written approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.1.5.7 If final completion of the Work is materially delayed through no fault of the Contractor, then the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A232-2019.

(Paragraphs deleted)

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to when the Work of this Contract is substantially complete, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

.1 Pursuant to N.J.S.A. 18A: 18-40.3, unless indicated otherwise in the Contract Documents, if the Contractor does have a performance bond, 2% of the amount due on each partial payment shall be withheld by the Owner when the outstanding balance of the contract exceeds $500,000, and 5% of the amount due on each partial payment shall be withheld by the Owner when the outstanding balance of the Contract is $500,000 or less, until final completion and acceptance of all work covered by the Contract until final completion and acceptance of all work covered by the Contract, including the completion of all corrective or punch list items. Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute may be included as provided in Section 7.3 of the General Conditions.

.2 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Sum allocable to that portion of the Work in the schedule of values, less retainage of two percent (2%) when the contract balance is over $500,000 and five percent (5%) when the contract balance is $500,000 or less. **.3** Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of two percent (2% when the Contract balance is over $500,000 and five percent (5% when the contract balance is $500,000 or less**.**

.**4** Retainage shall be withheld until the Owner approves the Architect's determination that the work has been satisfactorily completed and no unsettled claims exist. The final acceptance shall not be binding or conclusive upon the Owner should it subsequently discover that the Contractor has supplied inferior material or workmanship or has departed from the terms of his contract. Should such a condition appear the Owner shall have the right, notwithstanding final acceptance and payment, to cause the work to be properly done in accordance with the drawings and specifications at the cost and expense of the Contractor.

(Paragraphs deleted)

§ 5.2 Final Payment

§ 5.2.1 Final Payment Where the Contract Sum is Based on a Stipulated Sum

§ 5.2.1.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect.

§ 5.2.1.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the final Certificate for Payment or Project Certificate for Payment or as follows: The Architect will submit the final Certificate for Payment once the Contractor has satisfactorily addressed all punch-list items and requisite close-out documents, including but not limited to, the Release of Mechanic Lien claims of all sub-contractors, suppliers and other contractor(s).

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(Paragraphs deleted)

§ 5.3 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Paragraph deleted)

Interest at a rate equal to the prime rate plus 1%.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as Initial Decision Maker pursuant to Article 15 of AIA Document A232–2019, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

[ ] Arbitration pursuant to Article 15 of AIA Document A232–2019.

[X] Litigation in a court of competent jurisdiction.

[ ] Other: *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction. If there are any claims or disputes, the Contractor is to submit in accordance with Article 15 as a pre-requisite to such a claim. Notwithstanding the foregoing and anything construed to the contrary, the foregoing shall only be applicable in the event that: (i) the Contractor has produced an updated Schedule prior to the alleged material delay; (ii) there are no components of the project for which the Contractor has delayed; and (iii) the alleged materially delayed component of the project affects the critical path and no other Work can continue to keep the project on schedule.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2019.

§ 7.1.2 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A232–2019, then the Owner shall pay the Contractor a termination fee as follow: No Termination Fee.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2019 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

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§ 8.1.1 A condition of this Agreement is that the Contractor will comply with all applicable governmental laws and regulations including, but without limitation, those set forth in Section 00860 of the Specifications, which are hereby incorporated by reference as if set forth herein at length.

§ 8.4 The Contractor's representative shall not be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Contractor shall purchase and maintain insurance as set forth in AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A132™–2019, Exhibit A, and elsewhere in the Contract Documents.

§ 8.7 Relationship of the Parties

:

(Paragraphs deleted)

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition

.2 AIA Document A132™–2019, Exhibit A, Insurance and Bonds Exhibit (Bond requirements are intended to comply with the Public Works Bond Act, N.J.S.A 2A:44-143-147. Any conflicting provisions are deleted and replaced with those conforming to applicable law.)

.3 AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition and its revisions.

.4 Drawings

Number	Title	Date

.5 Specifications

Section	Title	Date	Pages
Part 1	Contract Conditions and General Requirements		In Full

.6 Addenda, if any:

None at this time, but subject to change.

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.7 Other Exhibits:

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[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
Part 1	Contract Conditions and General Requirements		In Full

.8 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A232–2019 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

Proposal, dated
Exhibit B

This Agreement is entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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AIA® Document A132® – 2019 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month, and year.)

for the following **PROJECT**:
(Name and location or address)

THE OWNER:
(Name, legal status, and address)

Princeton Public Schools Board of Education
25 Valley Road, Princeton, NJ 08540

THE CONTRACTOR:
(Name, legal status, and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A232™–2019, General Conditions of the Contract for Construction.

(Paragraphs deleted)

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A232™–2019, General Conditions of the Contract for Construction. Article 11 of A232™–2019 contains additional insurance provisions

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Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies. The coverage maintained by the Contractor shall be written by companies licensed to do business in the State where the project is located and maintaining an AM BEST rating of A- or better with a financial size rating of Class IX or larger. If the Contractor fails to maintain any insurance required hereunder, then, in addition to all other remedies given to the Owner in case of the breach of any conditions or covenants of this Contract, the Owner may (but shall not be obligated to) secure or pay the premium for any such policy or policies and charge the Contractor therefor the cost of such premiums.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor. Such deductibles or self-insured retentions shall be subject to the Owner's approval. The Contractor shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor (and all Subcontractors) shall cause the commercial general liability coverage to include (1) the Owner, the Architect and the Architect's consultants, and the Construction Manager and the Construction Manager's consultants, as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, and the Construction Manager and the Construction Manager's consultants, CG 20 32 07 04. The Products and Completed Operations insurance shall be maintained for five (5) years after final payment or the then current applicable statue of repose. A "per project endorsement" shall be included, so that the general aggregate limit applies solely to the project that is the subject of this contract.

§ A.3.1.4 All insurance shall contain a waiver of subrogation against the Owner.

§ A.3.1.5 Contractor shall, without in any way altering Contractor's liability under the Contract or applicable law, obtain, pay for and maintain insurance for the coverages and amounts of coverage not less than those set forth below in the Schedule of Insurance Coverages and shall provide to Owner certificates issued by insurance companies satisfactory to Owner to evidence such coverage no later than 7 days of the date of the execution of this Contract and prior to any personnel or equipment being brought onto and/or before any work commences at the job site. The coverage afforded under any insurance obtained pursuant to this paragraph shall be primary to any valid and collectible insurance carried separately by any of the indemnities. Such certificates shall provide that there shall be no cancellation, non-renewal or material change of such coverage without thirty (30) days prior written notice to Owner. In the event of any failure by Contractor to comply with the provisions of this Article 11, Owner may, at its option, on notice to Contractor, suspend the Contract for cause until there is full compliance with this Article 11 and/ or terminate the Contract for cause. Alternatively, Owner may purchase such insurance at Contractor's expense, and charge the Contractor therefor the cost of such premiums plus fifteen percent (15%) as an administrative fee to the Owner, provided that Owner shall have no obligation to do so, and if Owner shall do so, Contractor shall not be relieved of or excused from the obligation to obtain and maintain such insurance amounts and coverages. Contractor shall provide to Owner a copy of any and all applicable insurance policies. The Owner shall be named as an additional insured on a primary and non-contributory basis on all Insurance Policies to be provided by the Contractor

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions. The Contractor shall either require each of his subcontractors to procure and to maintain during the life of their subcontracts, subcontractor's public liability and property damage, of the type and in the same amounts as specified below; or insure the activities of their subcontractors under their respective policies.

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§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than two million dollars ($ 2,000,000.00) each occurrence, two million dollars ($ 2,000,000.00) general aggregate, and two million dollars ($ 2,000,000.00) aggregate for products-completed operations hazard (and independent contractor liability), providing coverage for claims including

.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;

.2 personal injury and advertising injury;

.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;

.4 bodily injury or property damage arising out of completed operations; and

.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

.6 the policy shall name the Owner, Architect, Construction Manager and their Consultants, Agents and Employees as additional insured.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.

.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.

.3 Claims for bodily injury other than to employees of the insured.

.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.

.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.

.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.

.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.

.8 Claims related to roofing, if the Work involves roofing.

.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.

.10 Claims related to earth subsidence or movement, where the Work involves such hazards.

.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than one million dollars ($ 1,000,000.00) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits applicable to the laws of the State of project location and other State or Federal jurisdiction required to protect the employees of the Contractor and any Subcontractor who will be engaged in the performance of this Contract. The certificate must also indicate that no proprietor, partner, executive officer, or member is excluded. This insurance shall include Employers' Liability Protection.

§ A.3.2.6 Employers' Liability with policy limits not less than one million dollars ($1,000,000) bodily injury, each occurrence, one million dollars ($1,000,000) disease, each employer, and one million dollars ($1,000,000) disease,

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aggregate limit. Including the employer's liability insurance under the umbrella insurance can satisfy the limit requirements.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ($) per claim and ($) in the aggregate.

A.3.2.13 Excess Liability, umbrella insurance form, applying excess of primary to the commercial general liability, commercial automobile liability and employer's liability insurance shall be provided with minimum limits in an amount such that the commercial general liability insurance and excess/umbrella is equal to $1,000,000 per occurrence, general aggregate, and products/completed operations.

§ A.3.2.14 The General Liability insurance, General Aggregate and Umbrella Excess Liability limits shall apply and be written exclusively, in total, to this Project only. A per project endorsement for all coverages and limits must be included in each policy.

A.3.2.14.1 Bodily injury and property damage insurance policies shall be so written as to provide coverage for special hazards where such hazards will be incidental to subcontractors' work.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[ ] **§ A.3.3.2.1** If there is only one Contractor performing the Work on the Project, property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:

(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

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[ ] **§ A.3.3.2.2 Railroad Protective Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for Work within fifty (50) feet of railroad property.

[ ] **§ A.3.3.2.3 Asbestos Abatement Liability Insurance**, with policy limits of not less than ($) per claim and ($) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[ ] **§ A.3.3.2.4** Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[ ] **§ A.3.3.2.5** Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[ ] **§ A.3.3.2.6 Other Insurance**
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	**Limits**

§ A.3.4 Performance Bond and Payment Bond
The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
(Specify type and penal sum of bonds.)

Type	**Penal Sum ($0.00)**
Payment Bond	Amount equal to the Contract Sum
Performance Bond	Amount equal to the Contract Sum
Maintenance Bond	Amount equal to the Contract Sum or as otherwise provided in the Contract Documents

§ A.3.4 .1 Contractor shall furnish each of the performance bond and payment bond meeting all statutory requirements of the State of New Jersey in form and substance satisfactory to the Owner and, without limitation, complying with the following specific requirements:

.1 Except as otherwise required by statute, the form and substance of such bonds shall be satisfactory to the Owner in the Owner's sole judgment;

.2 The bonds shall be executed by an approved surety company authorized to do business in the State of New Jersey and in accordance with N.J.S.A. 2A:44-143 and 2A:44-144, and with the three highest rating categories of rating companies nationally recognized and listed as per Appendix A, (go to www.nj.gov/dobi/surety.htm), and shall remain in effect for a period of not less than one year following the date of substantial completion or the time required to resolve any items of incomplete or inadequate work and the payment of any disputed amounts, whichever time period is longer;

.3 The performance bond and the labor and material payment bond shall each be in an amount equal to the Contract Sum;

.4 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his/her power of attorney indicating the monetary limit of such power;

.5 Any bond under this Paragraph 11.6.1 must display the surety's bond number. A rider including the following provisions shall be attached to each bond:

.1 Surety hereby agrees that it consents to and waives notice of any addition, alteration, omission, change or other modification of the Contract Documents. Any other alterations, change, extension of time or other modification of the Contract Documents or a forbearance on the part of either the Owner or the Contractor to the other shall not release the surety of its obligations hereunder and notice to surety of such matter is hereby waived.

.2 Surety further agrees that in the event of any default by the Owner in the performance of

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the Owner's obligations to the Contractor under the Contract, the Contractor or surety shall cause written notice of such default (specifying said default in writing) to be given to the Owner, and the Owner shall have thirty (30) calendar days after receipt of such notice within which to cure such default or such additional reasonable time as may be required if the nature of such default is such that it cannot be cured within thirty (30) calendar days. Such notice of default shall be sent by certified or registered U.S. mail, return receipt requested, first class postage, prepaid to the Owner.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

None.

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AIA® Document A232® – 2019

General Conditions of the Contract for Construction, *Construction Manager as Adviser Edition*

for the following PROJECT:
(Name, and location or address)
Renovations to Princeton High School
151 Moore St., Princeton, NJ 08540

THE CONSTRUCTION MANAGER:
(Name, legal status, and address)
New Road Construction Management Company, Inc.
1876 Greentree Road, Cherry Hill, NJ 08003

THE OWNER:
(Name, legal status, and address)

Princeton Public Schools Board of Education
25 Valley Road, 2nd Floor, Princeton, NJ 08540

THE ARCHITECT:
(Name, legal status, and address)

Fraytak Veisz Hopkins Duthie, P.C. Architects - Planners
1515 Lower Ferry Road, Trenton, NJ 08618

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents. The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents shall include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract. The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and the Construction Manager or the Construction Manager's consultants, (3) between the Owner and the Architect or the Architect's consultants, (4) between the Contractor and the Construction Manager or the Construction Manager's consultants, (5) between the Owner and a Subcontractor or Sub-subcontractor (6) between the Construction Manager and the Architect, or (7) between any persons or entities other than the Owner and Contractor. The Construction Manager and Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of their duties.

§1.1.2.1 The Contractor acknowledges and warrants that it has closely examined all of the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the Work in a timely manner for the Contract Sum, and that they include all Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the competition of the Work in full compliance with all applicable codes, laws, ordinances and regulations and that questions regarding the bid documents and any interpretation(s) regarding same have been asked by the Contractor, in the form and manner required in the instructions to bidders.

§1.1.2.2 In connection therewith, Contractor specifically represents and warrants to Owner that it has, by careful examination, satisfied itself as to: (1) the nature, location, and character of the general area in which the Project is located, including without limitation, its climatic conditions, available labor supply and labor costs, and available equipment supply and equipment costs; and (2) the quality and quantity of materials, supplies, tools, equipment, labor, and professional services necessary to complete the Work in the manner and within the cost and time frame required by the Contract Documents; and (3) the condition of existing and planned structures on the site and the ability, safety and appropriateness of same to receive the Work in the manner required by the Contract Documents.

§ 1.1.3 The Work. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by other Contractors, and by the Owner's own forces and Separate Contractors.

§ 1.1.5 Contractors. Contractors are persons or entities, other than the Contractor or Separate Contractors, who perform Work under contracts with the Owner that are administered by the Architect and Construction Manager.

§ 1.1.6 Separate Contractors. Separate Contractors are persons or entities who perform construction under separate contracts with the Owner not administered by the Architect and Construction Manager.

§ 1.1.7 The Drawings. The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

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§1.1.7.1. Construction Drawings prepared by the Architect are intended to show the scope of work, including but not limited to general arrangement of stairs, equipment, ducts, piping and other elements of the structure, and approximate locations and sizes of equipment. This does not relieve the Contractor from providing all connections and accessories necessary to make structural, mechanical and electrical work complete, ready to operate, in compliance with all applicable codes, laws and other regulations, and acceptable to the Architect. As such, they are not to serve as Shop Drawings.

§1.1.7.2 Locations and arrangements of items are designated by dimensions at less than full scale, unless otherwise noted. Such reductions of scale may vary and will be noted.

§1.1.7.3 Designs, information, reports and other materials and/or data may be performed and/or provided for the project by other than the Architect. Such designs, information, reports and other materials and/or data may include, without limitation, designs, information, reports and other materials and/or data performed and/or provided by the Contractor(s) or by Subcontractors and/or other consultants retained by the Contractor(s) and/or the Owner. Such designs, information, reports and other materials and/or data may include without limitation the locations, quantities, sizes, conditions and scope of specific items of the construction Work required to be provided for the Project. The Contractor shall immediately notify the Construction Manager and Architect in writing upon its discovery or knowledge of any errors, omissions or defects in any designs, information, reports and other materials and/or data prepared or provided by the Contractor or on the Contractor's behalf which are provided to the Architect for the Architect's preparation of its design documentation for the Project. The Contractor shall also be required to immediately notify the Architect in writing in the event that it discovers or becomes aware of any errors, omissions or defects in any designs, information, reports or other materials or data that are provided to the Architect by others for the preparation of the Architect's design documentation. The Contractor shall also be required to immediately notify the Construction Manager and Architect in writing if it discovers or becomes aware of any discrepancies between any design documentation prepared by the Architect and any designs, information, reports or other materials and/or data provided to the Architect by the Contractor(s), the Owner, Subcontractors or Subconsultants retained by the Contractor(s) or Owner, or by others. In such event, the Contractor shall promptly submit a written request for resolution of such discrepancy to the Architect and Owner.

§ 1.1.8 The Specifications. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.9 Instruments of Service. Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.10 Initial Decision Maker. The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§1.2.3.1 In the event of a conflict or an inconsistency in or among the Contract Documents, or between the Contract Documents and applicable codes in effect at the time the Contract Sum is bid or negotiated, the Contractor shall, unless directed otherwise in writing by and Addendum or Change Order, provide the greatest quantity, highest quality, highest degree of safety and most stringent material, equipment or Work.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. Any information or data obtained or derived from electronic files to create shop drawings or other submissions must be compared with the hard paper Construction Documents issued by the Architect for construction. Use of electronic documents for any reason is at the user's sole risk.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk

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and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner may designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Construction Manager and the Architect do not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.2 Evidence of the Owner's Financial Arrangements

(Paragraphs deleted)

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities. Unless otherwise provided under the Contract Documents, the Owner, assisted by the Construction Manager, shall secure and pay for the building permit.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 The Owner shall retain a construction manager adviser lawfully practicing construction management in the jurisdiction where the Project is located. That person or entity is identified as the Construction Manager in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.4 If the employment of the Construction Manager or Architect terminates, the Owner shall employ a successor construction manager or architect to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Construction Manager or Architect, respectively.

§ 2.3.5 If necessary and requested by the Architect, the Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work. The furnishing of these surveys and the legal description of the site shall not relieve the Contractor from its duties under the Contract Documents. Neither the Owner nor Architect is required to provide subsurface information. Any such investigations were for their own purposes and are not part of the Contract Documents. If shared, this information is for convenience only and without warranty.

§ 2.3.6 If necessary and requested by the Architect, the Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.7 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3.8 The Owner shall forward all communications to the Contractor through the Construction Manager. Other communication shall be made as set forth in Section 4.2.6.

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§ 2.4 Owner's Right to Stop the Work

If, in the reasonable belief of the Owner, the Contractor fails to correct alleged defective Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, or fails or refuses to provide a sufficient amount of properly supervised and coordinated labor, materials, or equipment so as to be able to complete the Work within the Contract Time or fails to remove and discharge (within ten days) any lien filed upon Owner's property by anyone claiming by, though, or under Contractor, or disregards the instructions of Architect or Owner when based on the requirements of the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3, and the Contractor shall have no claim for damage by reason thereof.

§ 2.4.1 Notwithstanding the foregoing, the Owner shall have the authority to immediately correct, service, repair, replace or otherwise make operational any component of their facilities, including equipment, if, in the sole discretion of the Owner, the damaged component is a threat to education, safety, or security. The Owner is obligated to notify the Contractor of the issue threatening education, safety or security, and the Owner's intent to remedy immediately with other resources, backcharging the Contractor for the cost of said service. However, there is no obligation to provide the Contractor an opportunity to cure, as required for corrective actions necessary to protect the Owner's interest in education, safety, and security.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and (i) fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, or (ii) Owner and Architect reasonably believe that such correction cannot be properly completed within a twenty-day period, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to review by the Construction Manager and prior approval of the Architect, and the Construction Manager or Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Construction Manager's and Architect's and their respective consultants' additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner as approved by the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15. Notwithstanding the above, if deficiencies create an emergency threatening safety or property, the Owner may immediately correct the issue without prior notice, and deduct related costs from payments due the Contractor. This right does not relieve the Contractor of its obligations, nor does it impose any duty on the Owner to act for the benefit of the Contractor or others.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager or Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents. The Contractor has carefully examined the Plans, Specifications, and the site of the work, and based on their own investigations, the Contractor has satisfied themselves

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regarding the nature and location of the work, the character, quality, and quantity of the surface and subsurface materials likely to be encountered, the character of equipment and other facilities needed for the performance of the work, the general local conditions, and all other materials that may in any way affect the work or their performance.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.5, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. The Contractor shall satisfy itself as to the accuracy of all dimensions and locations. In all cases of interconnection of its work with existing or other work, it shall verify at the site, all dimensions relating to such existing or other work. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Construction Manager and Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information submitted to the Construction Manager in such form as the Construction Manager and Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents. If the Contractor performs any construction activity involving an error, inconsistency, nonconformity, or omission in the Contract Documents – which the Contractor either recognized or reasonably should have recognized – and fails to notify the Architect, the Contractor shall assume complete responsibility for such performance, including the full amount of attributable costs for correction and any damages to Owner, Architect, Owner's Representative, or Separate Contractors arising from that work. The Contractor may not be liable to the Owner for damage resulting from errors, inconsistencies or omissions in the Contract Documents that could not have been discovered by a prudent and experienced Contractor in advance and that are not in the nature described in and intended to be covered in the Contract Documents, unless the Contractor recognized or reasonably should have recognized such error, inconsistency or omission and failed to report it to the Architect. If the Contractor proceeds with construction activities involving such recognized or reasonably recognizable errors, inconsistencies, or omissions without notifying the Architect, the Contractor shall assume full responsibility for such work and bear all associated costs for correction.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Construction Manager and Architect any nonconformity discovered by or made known to the Contractor as a request for information submitted to Construction Manager in such form as the Construction Manager and Architect may require. Notwithstanding the foregoing, as an inducement for the Owner to execute the Owner-Contractor Agreement, the Contractor represents and warrants to the Owner (in addition to the other representations and warranties contained in the Contract Documents) that they are familiar with local ordinances and applicable building codes affecting the Work, and these representations and warranties shall survive the execution and delivery of the Owner-Contractor Agreement and the final completion of the Work.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor and/or their Surety shall pay such costs and damages to the Owner, subject to section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations of Sections 3.2.2. or 3.2.3, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, unless the Contractor recognized or should have recognized such error, inconsistency, omission or difference and yet knowingly failed to timely report it to the Architect.

§3.2.4.1 The General Contractor shall perform no portion of the Work at any time without Contract Documents or, where required, approved Shop Drawings, Product Data or Samples for such portion of the Work.

§3.2.4.2 Should the General Contractor elect to release work without approvals, same shall be at his/her own risk and expense. Such work, if it is determined by the Architect and Construction Manager to not be in accordance with the requirements of the Contract Documents, shall be removed and replaced without additional cost or extension of time.

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§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner, the Construction Manager, and the Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. The Construction Manager shall review the proposed alternative for sequencing, constructability, and coordination impacts on the other Contractors. Unless the Architect or the Construction Manager objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of the Project already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect, in consultation with the Construction Manager, and in accordance with a Change Order or Construction Change Directive. The Owner may back charge the Contractor for expenses incurred due to the Contractor's error, act, omission, or noncompliance, with deductions made from payments due. The Contractor has 30 days to dispute a back charge; failure to do so constitutes acceptance and waiver of any objection.

§ 3.4.3 The Contractor shall maintain sufficient skilled workers on site at all times, as determined by the Contractor to perform the Work in the timeframe specified, with all Work supervised by a qualified Project Superintendent. The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them. The Contractor shall also at all times use best efforts and its judgment as an experienced General Contractor to adopt and implement policies and practices which are designed to avoid work stoppages, slowdowns, disputes or strikes; and shall at all times use best efforts to maintain project-wide labor harmony. The Owner reserves the right to require the Contractor to remove from the Project any of its personnel, or Subcontractor's personnel, for violating Owner's policies, rules or regulations.

§3.4.5 All materials delivered to the premises which are to form a part of the work are to be considered the property of the Owner and must not be removed without the Owner's consent. Materials not incorporated into the work shall become the Contractor's property and must be removed from the Project Site at or prior to Substantial Completion, unless other arrangements are made with the Owner.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner, Construction Manager, and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The

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Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Construction Manager or Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The Contractor's maintenance warranty shall be at least 2 years from Substantial Completion and shall not reduce any Manufacturer's Warranty period.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.5.3 The Contractor represents that all manufacturer and supplier warranties shall run directly to or be specifically assignable to the Owner. The Contractor warrants that all portions of the Work that will be covered by a manufacturer's or supplier's warranty shall be performed in such a manner so as to preserve all rights under such warranties. The Contractor hereby assigns to the Owner, effective upon the termination of this Contract, all manufacturer's and supplier's warranties relating to the Work; and the Contractor shall, upon request of Owner, execute any documents reasonably requested by Owner to effectuate such assignment. If the Owner attempts to enforce a claim based upon a manufacturer's or supplier's warranty and such manufacturer or supplier refuses to honor such warranty based in whole or in part on a claim of defective installation by the Contractor, the Contractor shall be responsible for any resulting loss or damages incurred by the Owner as a result of the manufacturer's or supplier's refusal to honor such warranty. The Contractor's obligation under this Subparagraph 3.5.3 shall survive the expiration or earlier termination of the Contract.

§ 3.5.4 The Contractor agrees that all warranties in the Contract Documents survive acceptance of, delivery of and payment for the goods, whether any defect shall be latent or patent. The Contractor agrees to correct, without expense to, and to the satisfaction of the Owner, any defects that may develop in the Work. Any facilities, including buildings and their contents, which have been damaged either directly or indirectly by the Work performed by the Contractor shall be repaired within ten (10) working days after receipt of written notice of the defect from the Owner by the Contractor at no cost to the Owner.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices, and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit. The Contractor shall secure and pay for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. The Contractor shall arrange for any inspections by governmental authorities needed to obtain any necessary occupancy permits.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§3.7.4 Prior to application for final payment, furnish a written certification that the Work is in conformance with applicable laws, ordinances, rules, regulations and lawful orders.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner, Construction Manager, and the Architect before conditions are

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disturbed and in no event later than 14 days after first observance of the conditions. The Architect and Construction Manager will promptly investigate such conditions and, if the Architect, in consultation with the Construction Manager, determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect, in consultation with the Construction Manager, determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner, Construction Manager, and Contractor, stating the reasons. If the Owner or Contractor disputes the Architect's determination or recommendation, either party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner, Construction Manager, and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, and in a manner consistent with N.J.S.A. 5:34-9.2, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

- **.1** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum; and
- **.3** whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2..

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants, acceptable to the Owner and Architect, who shall be in attendance at the Project site during performance of the Work, and until the final completion of all work, including all corrections and punch list items. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.1.1 The Contractor must provide a Superintendent for the project and a Foreman at each site during all work, including by subcontractors, ensuring adequate supervision. If supervision is deemed insufficient, the Contractor must add staff at no extra cost.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect, through the Construction Manager, of the name and qualifications of a proposed superintendent. Within ten (10) days of receiving the Notice to Proceed, the Contractor shall submit resumes for the proposed project manager and full-time superintendent, including at least three similar recent projects with Owner and Architect contact information for each. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor, stating whether the Owner, the Construction Manager, or the Architect (1) has reasonable objection to the proposed superintendent or (2) require additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection.

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§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner, Construction Manager, or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§3.9.4 The Contractor shall immediately remove from the Project, whenever requested by the Owner or Construction Manager, any employee, Project Manager or Superintendent who is considered by the Owner or Construction Manager to be incompetent or disposed to be disorderly, or who, for any reason, is not satisfactory to the Owner and the Project. The replacement shall be at no additional cost, and that person shall not be employed on the Project again without the consent of the Owner or Construction Manager.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information, and the Construction Manager's use in developing the Project schedule, a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. The Contractor shall cooperate with the Construction Manager in scheduling and performing the Contractor's Work to avoid conflict with, and as to cause no delay in, the work or activities of other Contractors, or the construction or operations of the Owner's own forces or Separate Contractors.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Construction Manager's and Architect's approval. The Architect and Construction Manager's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Construction Manager and Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall participate with other Contractors, the Construction Manager, and the Owner in reviewing and coordinating all schedules for incorporation into the Project schedule that is prepared by the Construction Manager. The Contractor shall make revisions to the construction schedule and submittal schedule as deemed necessary by the Construction Manager to conform to the Project schedule.

§ 3.10.4 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner, Construction Manager, and Architect, and incorporated into the approved Project schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Construction Manager, Architect, and Owner, and delivered to the Construction Manager for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data, and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

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§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect and Construction Manager is subject to the limitations of Sections 4.2.10 through 4.2.12. Informational submittals upon which the Construction Manager and Architect are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Construction Manager, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the Project submittal schedule approved by the Construction Manager and Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of other Contractors, Separate Contractors, or the Owner's own forces. The Contractor shall cooperate with the Construction Manager in the coordination of the Contractor's Shop Drawings, Product Data, Samples, and similar submittals with related documents submitted by other Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner, Construction Manager, and Architect, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been reviewed and approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Construction Manager and Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Construction Manager and Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner, the Architect, and the Construction Manager shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on

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submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Construction Manager shall review submittals for sequencing, constructability, and coordination impacts on other Contractors.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Construction Manager and Architect at the time and in the form specified by the Architect.

§ 3.12.10.3 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.12 Substitutions – All substitutions or deviations must be clearly noted on shop drawings. The Contractor is responsible for coordinating and covering any additional requirements, including change orders and extra work by other trades. Substitution requests must be submitted with 30 days of Notice to Proceed and should include a credit change order.

§ 3.13 Use of Site

§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.2 The Contractor shall coordinate the Contractor's operations with, and secure the approval of, the Construction Manager before using any portion of the site.

§**3.13.3** The Contractor shall send proper notices, make all necessary arrangements and perform all other services required in order to protect and maintain all marked, identified or known public utilities such a fire lines and plugs, electric, gas, water lines, sewer pipes, mechanical systems and all other items of this nature, and assume all responsibility and pay all costs for which the Owner may be liable if said services are interrupted by actions of the Contractor or Subcontractors . The Contractor acknowledges that all public utilities or other infrastructure may not be identified or marked, and Contractor acknowledges that all public utilities or other infrastructure may not be identified or marked and that Contractor has taken all reasonable precautions to identify all known and unknown utilities or other infrastructure. Only materials and equipment needed for the Work may be stored on site and must be removed when no longer needed. The Contractor is solely responsible for protecting stored items. No signs may be posted without Owner and Construction Manager approval. The Contractor must maintain safe access, keep adjacent areas clear of debris, and minimize disruption. Workers may use only designated facilities and must follow all Owner rules, insurance, and labor agreements. Any issues complying must be reported in writing with alternatives for Owner review.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner, Separate Contractors, or of other Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner, Separate Contractors, or by other Contractors except with written consent of the Construction Manager, Owner, and such other Contractors or Separate Contractors. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Separate Contractors, other Contractors, or the Owner, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste

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materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner, or Construction Manager with the Owner's approval, may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner, Construction Manager, and Architect with access to the Work in preparation and progress wherever located.

§3.16.1 The Contractor shall keep only necessary equipment on-site and shall cooperate with the Construction Manager regarding the location of stored material. No Contractor shall unreasonably encumber the Project site (or building) with equipment and stored material, and they shall afford other contractors a reasonable opportunity for the introduction and storage of their materials and the execution of other work.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner, Construction Manager, and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner, Architect, or Construction Manager. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect through the Construction Manager.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Construction Manager, Architect, Construction Manager's and Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), to the extent caused by the actual or alleged negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts in accordance with the New Jersey Tort Claims Act and the New Jersey Contractual Liability Act. The Contractor shall prevent any mechanics or other liens against the Project. If a lien is filed or served, the Contractor must have it discharged within 20 days or, if contesting in good faith, provide security to prevent foreclosure. The Owner may withhold payments sufficient to protect against the lien.

§3.18.3 The Contractor's indemnity obligations under this Section 3.18 shall also specifically include, without limitation, all fines, penalties, damages, liability, costs, expenses (including, without limitation, reasonable attorneys' fees) and punitive damages (if any) arising out of, or in connection with, and (i) violation of or failure to comply with any law, statute, ordinance, rules, regulations, code or requirement of a public authority that bears upon the performance of the Work by the Contractor, a Subcontractors or any person or entity for whom either is responsible, (ii) means, methods procedures, techniques or sequences of execution or performance of the Work, and (iii) failure to secure and pay for permits, fees, approvals, licenses and inspections as required under the Contract Documents, or any violation of any permit or other approval of a public authority applicable to the Work by the Contractor, Subcontractors or any person or entity for whom either is responsible.

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§3.18.4 The Contractor has determined what local ordinances, if any, will accent his work. The Contractor has checked for any County, City, Borough, or Township rules or regulations applicable to the area in which the Project is being constructed and in addition, for any rules or regulations of other organizations having jurisdiction, such as chambers-of-commerce, planning commission, industries, or utility companies who have jurisdiction over property on which the Work will be performed. Any costs of compliance with local controls are included in the prices bid, even if documents of such local controlling agencies are not listed specifically in the Contract Documents.

§3.18.5 If the Contractor makes any significant changes to the form, type, system, or details from the Drawings — due to approval of substitute equipment or otherwise —they shall pay all related costs, including architectural and engineering review fees. All changes require prior written approval from the Architect. The Contractor must reimburse the Owner for site visit or redesign costs caused by the Contractor's fault or deficiencies.

ARTICLE 4 ARCHITECT AND CONSTRUCTION MANAGER

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 The Construction Manager is the person or entity retained by the Owner pursuant to Section 2.3.3 and identified as such in the Agreement.

§ 4.1.3 Duties, responsibilities, and limitations of authority of the Construction Manager and Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Construction Manager, Architect, and Contractor. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Construction Manager and Architect will provide administration of the Contract as described in the Contract Documents and will be the Owner's representatives during construction until the date the Architect issues the final Certificate for Payment. The Construction Manager and Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become reasonably informed with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of the site visits, the Architect will keep the Owner and the Construction Manager reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner and Construction Manager known deviations from the Contract Documents and defects and deficiencies observed in the Work.

§ 4.2.3 The Construction Manager shall provide one or more representatives who shall be in attendance at the Project site whenever the Work is being performed. The Construction Manager will determine in general if the Work observed is being performed in accordance with the Contract Documents, will keep the Owner and Architect reasonably informed of the progress of the Work, and will promptly report to the Owner and Architect known deviations from the Contract Documents and the most recent Project schedule, and defects and deficiencies observed in the Work.

§ 4.2.4 The Construction Manager will schedule and coordinate the activities of the Contractor and other Contractors in accordance with the latest approved Project schedule to maintain all completion dates. Adherence to provided direction is required.

§ 4.2.5 The Construction Manager, except to the extent required by Section 4.2.4, and Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, and neither will be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. Neither the Construction Manager nor the Architect will have control over or charge of, or be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or of any other persons or entities performing portions of the Work. No claims by any

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Contractor for delay or cost will be entertained if the Owner determines that said Contractor and their Subcontractors have been uncooperative with the Construction Manager.

§ 4.2.6 Communications. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner shall communicate with the Contractor and the Construction Manager's consultants through the Construction Manager about matters arising out of or relating to the Contract Documents. The Owner and Construction Manager shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Construction Manager otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with other Contractors shall be through the Construction Manager. Communications by and with the Owner's own forces and Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.7 The Construction Manager and Architect will review and certify all Applications for Payment by the Contractor, in accordance with the provisions of Article 9.

§ 4.2.8 The Architect and Construction Manager have authority to reject Work that does not conform to the Contract Documents, and will notify each other about the rejection. Whenever the Construction Manager considers it necessary or advisable, the Construction Manager will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, upon written authorization of the Owner, whether or not the Work is fabricated, installed or completed. The foregoing authority of the Construction Manager will be subject to the provisions of Sections 4.2.18 through 4.2.20 inclusive, with respect to interpretations and decisions of the Architect. However, neither the Architect's nor the Construction Manager's authority to act under this Section 4.2.8 nor a decision made by either of them in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect or the Construction Manager to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons performing any of the Work.

§ 4.2.9 Utilizing the submittal schedule provided by the Contractor, the Construction Manager shall prepare, and revise as necessary, a Project submittal schedule incorporating information from other Contractors, the Owner, Owner's consultants, Owner's Separate Contractors and vendors, governmental agencies, and participants in the Project under the management of the Construction Manager. The Project submittal schedule and any revisions shall be submitted to the Architect for approval.

§ 4.2.10 The Construction Manager will receive and promptly review for conformance with the submittal requirements of the Contract Documents, all submittals from the Contractor such as Shop Drawings, Product Data, and Samples. Where there are other Contractors, the Construction Manager will also check and coordinate the information contained within each submittal received from the Contractor and other Contractors, and transmit to the Architect those recommended for approval. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Construction Manager represents to the Owner and Architect that the Construction Manager has reviewed and recommended them for approval. The Construction Manager's actions will be taken in accordance with the Project submittal schedule approved by the Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness while allowing sufficient time to permit adequate review by the Architect.

§ 4.2.11 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Upon the Architect's completed review, the Architect shall transmit its submittal review to the Construction Manager.

§ 4.2.12 Review of the Contractor's submittals by the Construction Manager and Architect is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Construction Manager and Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5,

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and 3.12. The Construction Manager and Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.13 The Construction Manager will prepare Change Orders and Construction Change Directives.

§ 4.2.14 The Construction Manager and the Architect will take appropriate action on Change Orders or Construction Change Directives in accordance with Article 7, and the Architect will have authority to order minor changes in the Work as provided in Section 7.4. The Architect, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.15 Utilizing the documents provided by the Contractor, the Construction Manager will maintain at the site for the Owner one copy of all Contract Documents, approved Shop Drawings, Product Data, Samples, and similar required submittals, in good order and marked currently to record all changes and selections made during construction. These will be available to the Architect and the Contractor, and will be delivered to the Owner upon completion of the Project.

§ 4.2.16 The Construction Manager will assist the Architect in conducting inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion in conjunction with the Architect pursuant to Section 9.8; and receive and forward to the Owner written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10. The Construction Manager will forward to the Architect a final Application and Certificate for Payment or final Project Application and Project Certificate for Payment upon the Contractor's compliance with the requirements of the Contract Documents.

§ 4.2.17 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Construction Manager of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.18 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of the Construction Manager, Owner, or Contractor through the Construction Manager. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.19 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions so rendered in good faith.

§ 4.2.20 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.21 The Construction Manager will receive and review requests for information from the Contractor, and forward each request for information to the Architect, with the Construction Manager's recommendation. The Architect will review and respond in writing, through the Construction Manager, to requests for information about the Contract Documents. The Construction Manager's recommendation and the Architect's response to each request will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

§ 4.2.22 The Architect has final say on material or equipment substitutions and may waive specifications, accept superior alternatives, or require specified products. The Contractor must submit credit proposals and may be responsible for review costs. Approval does not relieve the Contractor of responsibility for the work, guarantees, or necessary related modifications.

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ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include other Contractors or Separate Contractors or the subcontractors of other Contractors or Separate Contractors.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, within 15 days after award of the Contract, shall notify the Construction Manager, for review by the Owner, Construction Manager and Architect, of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor whether the Owner, the Construction Manager or the Architect (1) has reasonable objection to any such proposed person or entity or, (2) requires additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner, Construction Manager or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Construction Manager or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner, Construction Manager or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, that the Contractor, by these Contract Documents, assumes toward the Owner, Construction Manager and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner, Construction Manager and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors. The Contractor shall obligate each Subcontractor to comply with the Public Works General Contractor Registration Act of the State of New Jersey.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

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.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor Contractor or other entity. If the Owner assigns the subcontract to a successor Contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor Contractor's obligations under the subcontract.

§ 5.4.4 When the Contractor sublets any Work, full responsibility for dividing, managing, coordinating, and inspecting the Work remains with the Contractor. The Owner and Architect are not responsible for disputes between the Contractor and Subcontractors; the Contractor must resolve any such issues affecting the project's progress, quality, or completion at no cost to the Owner.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction with Own Forces and to Award Other Contracts

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When the Owner performs construction or operations with the Owner's own forces or Separate Contractors, the Owner shall provide for coordination of such forces and Separate Contractors with the Work of the Contractor, who shall cooperate with them. Owner or separate contractor actions alone don't justify delay or cost claims. Extensions or costs apply only if delays result from: (1) Owner's bad faith, willful misconduct, or fundamental breach (documented and timely); (2) unforeseen, unmitigable delays by separate contractors; or (3) delays indicating Owner's intentional contract abandonment. Minor or typical construction delays don't qualify.

§ 6.1.3 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner's own forces, Separate Contractors, Construction Manager and other Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner's own forces, Separate Contractors or other Contractors, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Construction Manager and Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor or other Contractors that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Construction Manager and the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's or other Contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable. If the Contractor incurs cost or damage due to the failure of another Separate Contractor(s) to perform their contract with the Owner, no action can be taken against the Owner. The Owner bears no liability for such

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damages. Instead, the Contractor may assert its claim for damages against the Separate Contractor responsible as a third-party beneficiary under the Contract between the other Contractor and the Owner.

§ 6.2.3 Costs from delays, mis-timed work, or defects are the sole responsibility of those at fault. The Owner, Construction Manager, and Architect are not liable for any contractor claims or damages from delays. The only remedy for delay against the Owner is an extension of time to complete the work.
§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction, or to property of the Owner, Separate Contractors, or other Contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner, Separate Contractors, and other Contractors shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, other Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, or if the Contractor refuses to clean up debris, the Owner may, after 24 hours written notice, clean up. The Construction Manager, with notice to the Architect, will allocate the cost among those responsible as the Owner determines to be just.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§7.1.1.1 When submitting its change proposal, the Contractor shall include and set forth in clear and precise detail breakdowns of labor and materials for all trades involved and the estimated impact on the construction schedule, based upon an impact analysis of the current schedule. The Contractor shall furnish spreadsheets from which the breakdowns were prepared, plus spreadsheets, if requested, of any Subcontractor. Agreement on a Change Order fully settles all related costs and schedule adjustments. No compensation is allowed for work or delays outside the Change Order, and the Contractor is not entitled to lost profits, consequential, or incidental damages.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Construction Manager, Architect and Contractor. A Construction Change Directive requires agreement by the Owner, Construction Manager and Architect and may or may not be agreed to by the Contractor, however, the Contractor is obligated to perform and shall in no case refuse to perform. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

A Change Order is a written instrument prepared by the Construction Manager and signed by the Owner, Construction Manager, Architect, and Contractor, stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Construction Manager and signed by the Owner, Construction Manager and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

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§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

.2 Unit prices stated in the Contract Documents or subsequently agreed upon;

.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Contract must proceed diligently with the disputed work. The Construction Manager shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Construction Manager and Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others; and

.4 Costs of supervision and field office personnel directly attributable to the change, provided there's documented evidence of hours and tasks. Claims require prior written approval and detailed supporting documentation, subject to the Architect's review..

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Construction Manager of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Construction Manager and Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Construction Manager and Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Construction Manager and Architect determine to be reasonably justified. The interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Construction Manager and Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the

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adjustments, such agreement shall be effective immediately and the Construction Manager shall prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted. The increased contract unit price shall not apply to quantities scheduled under the contract for delivery before the effective date of the increased contract unit price, unless failure to deliver before that date results from causes reasonably beyond the Contractor's control and without his or her fault or negligence.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Construction Manager and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Construction Manager that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day of twenty-four (24) hours, beginning at 12:00 midnight, unless otherwise specifically defined. The term "working day" (or "business day") shall mean any calendar day except Saturdays, Sundays and legal holidays at the place of the Project. A time limit ending on a weekend or holiday shall be automatically extended to the succeeding working day.

§ 8.1.5 The Contract Time shall commence as of the date of the Notice to Proceed unless otherwise specified in the Agreement. However, the Work to be performed under this Contract shall not commence until the required insurance has been obtained or approved. The date shall not be postponed by the failure to act by the Contractor or of persons or entities for whom the Contractor is responsible.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time. If the Contractor reasonably anticipates, or reasonably should anticipate the potential impact of a delay on the progress of the Work, or if the Work has not progressed to the extent required to maintain the Project Construction Schedule for reasons unrelated to Contractor's entitlement to any extension of the Contract Time under the Contract Documents, and it is reasonably unlikely that the Work will be Substantially Complete by the required date, then the Construction Manager and/or the Owner shall have the right to order Contractor to increase manpower, work hours, and equipment necessary to maintain the Project Construction Schedule ("Acceleration Measures"), and shall be without additional cost or charge to the Owner.

§8.2.4 The Construction Manager, in coordination with the Contractor, will set work hours. The Contractor will be required to work nights, weekends or holidays as necessary to complete the work in accordance with the Schedule.

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NOTE: Standard work hours for this project may be affected by local Noise Ordinance. The Contractor shall be responsible to adhere to the Noise Ordinance, including night, weekend and holiday work. All utility shut downs, interruptions and work in or adjacent to an existing building will be coordinated through the Construction Manager and may have to be performed during hours when the facility is not in operation. All costs associated with this Article 8.2.4 are the responsibility of the Contractor and shall not be considered additional costs to the Owner.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) a deliberate, willful and malicious act or gross neglect of the Owner, Architect, Construction Manager; (2) by material changes ordered in the Work; (3) by fire, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's reasonable control not due to its fault or negligence, and which could have been prevented or avoided by the affected Party through the exercise of reasonable due diligence; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts and the Architect, based on the recommendation of the Construction Manager, determines justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine. Claims against the Owner for delay costs by another Prime Contractor are subject to Section 8.3.3.

§8.3.1.1 Where the cause of delay is due to the weather conditions, extension of time shall be granted only for unusually severe weather, as determined by reference to historical data. The term "historical data" as used in the preceding sentence shall be construed according to this formula: Average rainfall (or snow, or extreme low temperature) for the past five (5) years for the month in question, plus twenty (20) percent. In other words, weather is not deemed to be unusually severe unless it is twenty (20) percent worse that the average for that month over the last five (5) years.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15. An extension of time will only be granted if delays affect the Contract Completion Date. Incidental delays that use float do not qualify. The Construction Manager may require a time impact analysis to validate and extension.

§ 8.3.3 No payment or allowance of any kind or extension of time shall be made to the Contractor as compensation for damages on account of hindrance or delay from any cause in the progress of the Work, when the Architect determines the delay to be: (i) avoidable, (ii) caused by the Contractor's negligence or intentional misconduct in whole or in part, (iii) attributed to the Contractor's fault (in whole or in part) for the delay, including but limited to any delay attributable to lack of coordination or cooperation by or between the Contractor and his Subcontractors; (iv) caused by Owner unless based on a sustainable and valid claim of Owner negligence or intentional act; or (v) the result of any reason contemplated by the parties at the time of execution of this Agreement. The Contractor's only remedy for approved delays is a time extension per Section 8.3, equal to the delay period. The Owner and Architect are not liable for any losses or increased costs due to such delays. If the Contractor sues the Owner or Architect over delay costs and does not substantially prevail, the Contractor must reimburse their legal and related fees.

§ 8.3.4 The Contractor shall not be entitled to make a claim for delay (regardless of the cause of the delay) unless within two (2) business days after the beginning of such delay or delays, the Contractor files a written request providing notification of the delay (including specific explanation as to the cause) with the Architect, Construction Manager and Owner. In case of a continuing cause of delay, only one request is necessary.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents. This Article shall be in compliance with the Prompt Payment Act under N.J.S.A. 2A:30A-1, et seq. and the retention procedures established in N.J.S.A. 18A:18A-1, et seq.

(Paragraph deleted)

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Construction Manager, before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported

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by the data to substantiate its accuracy, required by the Construction Manager and the Architect. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. The Construction Manager shall forward to the Architect the Contractor's schedule of values. Any changes to the schedule of values shall be submitted to the Construction Manager and supported by such data to substantiate its accuracy as the Construction Manager and the Architect may require, and unless objected to by the Construction Manager or the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment. Each item shall show its total scheduled value, value of previous applications, value of the application, percentage completed, value completed and value yet to be completed.

§ 9.3 Applications for Payment

§ 9.3.1 At least fifteen days before the date established for each progress payment, the Contractor shall submit to the Construction Manager an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner, Construction Manager or Architect require, such as copies of requisitions, and releases of waivers of lien from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Construction Manager and Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contract ends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Where the Contract Documents permit payment for materials stored off the Project site, the Contractor shall procure insurance covering the full value of the material and, in addition to the other requisites of the Contract Documents, shall make any other provisions necessary to ensure and protect Owner's title and right of possession and access to such materials. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the reasonably-incurred costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work and stored materials covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, be free and clear of liens, claims, security interests, or encumbrances whatsoever, that the vesting of such title shall not impose any obligation on Owner or relieve the Contractor of any of its obligations under the Contract, that the Contractor remains responsible for damages or loss to the Work until the Owner accepts responsibility per the Contract Documents, and no Work covered by a Payment Application is subject to any seller's retained interest or encumbrance.

§ 9.4 Certificates for Payment

§ 9.4.1 Where there is only one Contractor, the Construction Manager will, within seven (7) days after the Construction Manager's receipt of the Contractor's Application for Payment, review the Application, certify the amount the Construction Manager determines is due the Contractor, and forward the Contractor's Application and Certificate for Payment to the Architect. Within seven (7) days after the Architect receives the Contractor's Application for Payment from the Construction Manager, the Architect will either issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, or notify the Construction Manager and Owner of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1. The Construction Manager will promptly forward to the Contractor the Architect's notice of withholding certification.

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§ 9.4.2 Where there is more than one Contractor performing portions of the Project, the Construction Manager will, within seven (7) days after the Construction Manager receives all of the Contractors' Applications for Payment: (1) review the Applications and certify the amount the Construction Manager determines is due each of the Contractors; (2) prepare a Summary of Contractors' Applications for Payment by combining information from each Contractor's application with information from similar applications for progress payments from the other Contractors; (3) prepare a Project Application and Certificate for Payment; (4) certify the amount the Construction Manager determines is due all Contractors; and (5) forward the Summary of Contractors' Applications for Payment and Project Application and Certificate for Payment to the Architect.

§ 9.4.2.1 Within seven (7) days after the Architect receives the Project Application and Project Certificate for Payment and the Summary of Contractors' Applications for Payment from the Construction Manager, the Architect will either issue to the Owner a Project Certificate for Payment for such amount as the Architect determines is properly due, or notify the Construction Manager and Owner of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1. The Construction Manager will promptly forward the Architect's notice of withholding certification to the Contractors.

§ 9.4.3 The Construction Manager's certification of an Application for Payment or, in the case of more than one Contractor, a Project Application and Certificate for Payment, shall be based upon the Construction Manager's evaluation of the Work and the data in the Application or Applications for Payment. The Construction Manager's certification will constitute a representation that, to the best of the Construction Manager's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified.

§ 9.4.4 The Architect's issuance of a Certificate for Payment or, in the case of more than one Contractor, Project Application and Certificate for Payment, shall be based upon the Architect's evaluation of the Work, the recommendation of the Construction Manager, and data in the Application for Payment or Project Application for Payment. The Architect's certification will constitute a representation that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to the results of subsequent tests and inspections, to the correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect and Owner.

§ 9.4.5 The representations made pursuant to Sections 9.4.3 and 9.4.4 are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Construction Manager or Architect.

§ 9.4.6 The issuance of a Certificate for Payment or a Project Certificate for Payment will not be a representation that the Construction Manager or Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum. The Owner retains all rights to verify and challenge any payment or work quality discrepancies despite the issuance of such certificates.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Construction Manager or Architect may withhold a Certificate for Payment or Project Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Construction Manager's or Architect's opinion the representations to the Owner required by Section 9.4.3 and 9.4.4 cannot be made. If the Construction Manager or Architect is unable to certify payment in the amount of the Application, the Construction Manager will notify the Contractor and Owner as provided in Section 9.4.1 and 9.4.2. If the Contractor, Construction Manager and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment or a Project Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. To the extent allowable by the Prompt Payment Act, the Construction Manager or Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment or Project Certificate for Payment previously issued, to such extent as may be necessary in the

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Construction Manager's or Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from the acts and omissions described in Section 3.3.2 because of

.1 defective Work not remedied;

.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;

.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

.4 reasonably avoidable delays or reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

.5 damage to the Owner or a Separate Contractor or other Contractor;

.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; as permitted by the Prompt Payment Act; or

.7 repeated failure to carry out the Work in accordance with the Contract Documents.

.8 failure to maintain the site in a safe and satisfactory manner in accordance with construction practices as determined by the Owner or Architect;

.9 any labor strike or labor disruption whatsoever which impacts the progress of the Work;

.10 claims made or likely to be made against the Owner or its property;

.11 loss caused by the Contractor or its Subcontractors;

.12 failure of the Contractor to correctly and accurately represent the Work performed in a payment request;

.13 the Contractor's failure to use funds previously paid to the Contractor to pay Project-related obligations;

.14 failure to update the Schedule(s);

.15 failure to maintain Record Drawings;

.16 deliberate delay in the submission for approval of names of Subcontractors, materialmen, sources of supply, product date, shop drawings and samples; or

.17 otherwise failure to comply with the requirements of the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15. If the Contractor disputes any determination of the Architect with respect to any Applications for Payment, the Contractor shall nevertheless continue to diligently prosecute the Work. In no event shall the General Contractor stop Work, except pursuant to Paragraph 9.7 hereof.

§ 9.5.3 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld. The Owner shall not be deemed in default of the Contract by reason of withholding payment while any of the above grounds remain uncured.

§ 9.5.4 If the Architect or Construction Manager withholds certification for payment under Section 9.5.1, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Construction Manager, and both will reflect such payment on the next Certificate for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment or Project Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Construction Manager and Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, within 10 days, in accordance with N.J.S.A. 2A:30A-2(b), the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Construction Manager will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Owner, Construction Manager and Architect on account of portions of the Work done by such Subcontractor.

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§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner, Construction Manager nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Provided the Owner has met its payment obligations, the Contractor shall indemnify and defend the Owner against any loss, liability, or expense, including attorney's fees, from lien claims or payment claims by any Subcontractor or supplier. Upon notice of such a claim, the Owner will notify the Contractor. With court approval when required, the Contractor may substitute a surety bond for the property subject to the claim.

(Paragraph deleted)

§ 9.7 Failure of Payment

If the Construction Manager and Architect do not issue an approved Certificate for Payment or a Project Certificate for Payment, through no fault of the Contractor, within fourteen days after the Construction Manager's receipt of the Contractor's Application for Payment, or if the Owner does not, for reasons other than a default of the Contract, including but not limited to those defaults set forth elsewhere in this Contract, pay the Contractor the certified and approved amount within 14 days after the date established in the Contract Documents, the amount certified by the Construction Manager and Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner, Construction Manager and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§9.7.1 If the Owner is entitled to reimbursement or payment from the Contractor pursuant to the Contract Documents, such payment shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or if the Owner incurs any costs and expenses to cure any default of the Contractor, including costs paid to other Contractors as a result of the Contractor's performance, or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to (i) deduct an amount equal to that which the Owner is entitled from any payment then or thereafter due the Contractor from Owner, or (ii) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that which the Owner is entitled.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use; provided, however, that as a condition precedent to Substantial Completion, the Contractor shall deliver to the Architect, with a copy to the Owner, all final and unconditional certificates of occupancy and any other permits or approvals necessary for Owner to occupy the entire Project or designate portions thereof.

§9.8.1.1 Substantial Completion shall not be achieved prior to the issuance of the Certificate of Occupancy issued by the state or local authority having jurisdiction.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Construction Manager, and the Contractor and Construction Manager shall jointly prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in strict accordance with the Contract Documents.

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.1 No later than (10) ten calendar days prior to date scheduled for Substantial Completion the Construction Manager and/or Owner may add additional items requiring completion or correction.

.2 The Contractor shall immediately proceed with the Work required by the Punchlist and shall complete and correct items on or added thereto by the date scheduled for Substantial Completion.

.3 When the Contractor determines that the Work has reached Substantial Completion, or when the Owner or Construction Manager so determines and directs the Contractor to do so, the Contractor shall request the Construction Manager's final inspection to determine Substantial Completion. The Contractor shall prepare and submit to the Architect and Owner its final Application for Payment submitted in compliance with the requirements of the Contract Documents and shall thoroughly reinspect the Work. Additionally, the Contractor shall prepare and submit to the Architect and Owner a comprehensive final Punchlist of any and all items remaining to be completed or corrected (whether or not included on any previous Punchlists).

§ 9.8.3 Upon receipt of the list, the Architect, assisted by the Construction Manager, will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect, assisted by the Construction Manager, to determine Substantial Completion.

§ 9.8.4 When the Architect, assisted by the Construction Manager, determines that the Work of all of the Contractors, or designated portion thereof, is substantially complete, the Construction Manager will prepare, and the Construction Manager and Architect shall execute, a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§9.8.6 The Architect's Certificate of Substantial Completion shall be subject to the Owner's final approval.

§ 9.8.7 In no case shall the time established for the completion and correction of items on the list extend beyond thirty (30) days after Certification of Substantial Completion, except for delay beyond the Contractor's reasonable control. The Contractor shall pay for all architectural and consultant services incurred thereafter due to the failure of Contractor to complete and / or correct the Work on the list or to submit documentation and items required for final completion and final payment. Payment for additional architectural and consultant services shall be deducted from the Contract amount.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor and Construction Manager shall jointly prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect after consultation with the Construction Manager.

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§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Construction Manager, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon completion of the Work, the Contractor shall forward to the Construction Manager a notice that the Work is ready for final inspection and acceptance, and shall also forward to the Construction Manager a final Contractor's Application for Payment. Upon receipt, the Construction Manager shall perform an inspection to confirm the completion of Work of the Contractor. The Construction Manager shall make recommendations to the Architect when the Work of all of the Contractors is ready for final inspection, and shall then forward the Contractors' notices and Application for Payment or Project Application for Payment, to the Architect, who will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Construction Manager and Architect will promptly issue a final Certificate for Payment or Project Certificate for Payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Construction Manager's and Architect's final Certificate for Payment or Project Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Document shall be assembled and delivered by the Contractor to the Architect as part of the final Application for Payment. The final Certificate for Payment will not be issued by the Architect or Construction Manager until all warranties and guarantees have been received and approved by the Architect and Construction Manager.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect through the Construction Manager (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees; and (7) evidence of compliance with all requirements of the Contract Documents: notices, certificates, affidavits, other requirements to complete obligations under the Contract Documents: including but not limited to (a) instruction of Owner's representatives in the operation of mechanical, electrical, plumbing and other systems, (b) delivery of keys to Owner with keying schedule: master, sub-master and special keys, (c) delivery to Architect of Contractor's General Warranty and each written warranty and assignment thereof prepared in duplicate, certificates of inspections, and bonds for Architect's review and delivery to Owner, (d) delivery to Architect a printed or typewritten operating, servicing, maintenance and cleaning instructions for all Work; parts lists and special tools for mechanical and electrical Work, in approval form, (e) delivery to the Architect of specified Project record documents and (f) delivery to Owner of a Final Waiver of Liens (AIA Document G-706 or other form satisfactory to Owner), covering all Work including that of all Subcontractors, vendors, labor, materials and services, executed by an authorized officer and duly notarized. In addition to the foregoing, all other submissions required by other articles and paragraphs of the Specifications including final construction schedule shall be submitted to the Architect before approval of final payment.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Construction Manager and Architect so confirm, the Owner shall, upon application by the Contractor and certification by the Construction Manager and

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Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect through the Construction Manager prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

.1 If more than one inspection for Final Completion is required, the Contractor will be billed and responsible for the professional fees and services of the Architect.

.2 Following Substantial Completion, in the event the Contractor or its subcontractor fails to complete the list of items of the Work instructed by the Architect to be corrected or completed within fourteen (14) days after the date of receipt of Certificate of Substantial Completion, the Owner may:

.1 exercise any available remedies to correct or complete deficient work or retain a third party of correct or complete such work at the cost of the defaulting Contractor; and

.2 retain and deduct from any payments or retention otherwise due to the defaulting Contractor fees and expenses for services required to be provided by the Architect more than twenty-one (21) days after the Date of Substantial completion.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

.1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;

.2 failure of the Work to comply with the requirements of the Contract Documents;

.3 terms of special warranties required by the Contract Documents; or

.4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall submit the Contractor's safety program to the Construction Manager for review and coordination with the safety programs of other Contractors. The Construction Manager's responsibilities for review and coordination of safety programs shall not extend to direct control over or charge of the acts or omissions of the Contractors, Subcontractors, agents or employees of the Contractors or Subcontractors, or any other persons performing portions of the Work and not directly employed by the Construction Manager.

§10.1.1 The Contrac `s attention is particularly directed to the governing agencies (State, Federal and Municipal, or other requirements) regarding reporting of accidents involving injury, loss of life and property damage.

§10.1.2 The Contractor will serve as the overall Project Safety Coordinator and shall be responsible for all issues of safety and protection. The Contractor, if applicable, shall also designate a safety person at the job site from notice to proceed to Contract completion. The designated safety person shall be responsible for the safety of their work and for their workers, and to make continuous inspections for all safety issues relating to his work. The Owner and their representatives, including but not limited to the Architect, the Construction Manager and the Owner's representative, are not responsible for safety on this project , but will endeavor to promote safety. The Contractor must comply with job Safety Requirements in addition to OSHA and local agency requirements. Failure to comply with safety issues will be ground for withholding of payments.

§ 10.1.3 The Contractor shall also insure that all of its Subcontractors follow its safety program and that this requirement is included in Contractor/Subcontractor Agreements. The Contractor should defend and indemnify Owner, Architect and Construction Manager for any damages or injuries arising for the failure of the Contractor to follow and/or enforce the safety program.

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§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor;

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction; and

.4 construction or operations by the Owner, Separate Contractors, or other Contractors.

.5 the general public

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards, consistent with applicable laws, statutes, ordinances, codes, rules and regulations and lawful orders of public authorities, and prevailing industry practice.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. In all cases, the Contractor shall give the Owner reasonable advance notice.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner, Construction Manager or Architect or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner, Construction Manager and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter. The Contractor shall provide and maintain adequate fire protection equipment, comply with reasonable recommendations from the fire insurer or local fire authorities, keep the site orderly, and promptly remove combustible rubbish.

§ 10.2.9 The Contractor shall protect excavations, trenches, buildings, and materials from water of any kind and promptly remove any accumulation, providing and operating all necessary pumps, piping, and equipment.

§ 10.2.10 The Contractor shall remove snow or ice which may result in damage, delay or hazardous conditions.

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§ 10.2.11 The Contractor shall take all necessary precautions to prevent loss or damage to Owner's property on the Project within areas accessible to the Contractor. The Contractor is fully responsible for the security of such property and shall reimburse the Owner for any loss, damage, or injury, including the Owner's Builder's Risk deductible, except when caused directly by the Owner's agents or employees.

§ 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner, Construction Manager and Architect of the condition. The Contractor is responsible for preventing mold in construction areas and must use dehumidification or other temporary heating, cooling, or ventilation as needed. If mold develops, the Contractor bears full responsibility and cost for remediation.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written directive of the Owner. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up. The Contract Time shall be extended as appropriate, but the Contractor shall not be entitled to compensation or damages for any delay.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Construction Manager, Architect, their consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's reasonable discretion, necessary to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or

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insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Construction Manager and Construction Manager's consultants, and the Architect and Architect's consultants, shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents. The coverage afforded under any insurance obtained pursuant to this paragraph shall be primary and non-contributory. Coverages should be written on an occurrence basis, and shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction. The Contractor shall indemnify, defend and hold harmless all parties or persons described in Section 3.18 from any and all claims for which the required insurance would have provided coverage. This indemnity obligation is in addition to any other indemnity obligation provided in the Contract.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice directly to the Owner, and separately to the Construction Manager, of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage. The Contractor's failure to obtain or maintain adequate insurance coverage shall be considered a material breach of the contract.

§ 11.2 Owner's Liability Insurance

§ 11.2.1 The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

(Paragraphs deleted)

§ 11.3 Waivers of Subrogation

§ 11.3.1 To the extent allowable under the New Jersey Tort Claims Act and the New Jersey Contractual Liability Act, the Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Construction Manager and Construction Manager's consultants; (3) the Architect and Architect's consultants; (4) other Contractors and any of their subcontractors, sub-subcontractors, agents, and employees; and (5) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Construction Manager, Construction Manager's consultants, Architect, Architect's consultants, other Contractors, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this Section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

(Paragraphs deleted)

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§ 11.4 Performance Bond and Payment Bond

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract. Bonds shall be obtained from a company lawfully authorized to do business in the location of the site and have an A.M. Best and Company rating of "A-" or better; and the cost of the bonds shall be included in the Contract Sum. The Contractor shall provide a Performance Bond equal to 100 percent of the Contract Sum, a Payment Bond equal to 100 percent of the Contract Sum, and a Two (2) Year Maintenance Bond equal to 100 percent of the Contract Sum. Bonds shall be consistent with the requirements of N.J.S.A. 2A:44-143, and 2A:44-144.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§11.4.3 The Contractor shall deliver the require bonds to the Owner not later than three (3) days following the date of the Agreement.

§11.4.4 The Contractor shall require the attorney who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the Power of Attorney, indicating the monetary limit of such power.

§11.4.5 The Contractor shall provide Owner and Construction Manager with the name, address, phone number and other contact information of the local agent of the Company issuing the Project bonds.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Construction Manager's, Architect's, or authority having jurisdiction's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by either, be uncovered for their observation, inspection, testing or approval,and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Construction Manager or Architect has not specifically requested to observe prior to its being covered, the Construction Manager or Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Construction Manager or Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion, and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within two year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the two-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during

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that period after receipt of notice from the Owner, Construction Manager or Architect, the Owner may correct it in accordance with Section 2.5. The Contractor shall bear all costs of correcting any and all Work not complying with this warranty, and the Contractor and its Surety shall indemnify the Owner for all costs, expenses, loses, and/or damages incurred by the Owner, including Attorney's fees, additional testing and inspections and compensation for the services and expenses of the Architect made necessary thereby. This obligation shall survive the termination of any or all other obligation or obligations under the contract Documents and it is agreed by the Contractor that in the event the Owner is required to bring suit under this provision against the Contractor to enforce this obligation, the Contractor hereby waives any defense of the statutes of limitations.

§ 12.2.2.2 The two-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The two-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner, Separate Contractors, or other Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the two-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§12.2.6 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 2.4. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Architect issued through the Construction Manager, the Owner may remove it and store the salvaged materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten (10) days after written notice, the Owner may, upon ten (10) additional days' written notice, sell such materials and equipment at auction or at private sale, and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Contractor, including compensation for the Construction Manager's and Architect's services and expenses made necessary thereby. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract Sum shall be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

§12.2.7 If, in the opinion of the Architect and the Construction Manager, the General Contractor delays Final Completion of the Work beyond a reasonable time after the Date of Substantial Completion of the Project to such extent that the period between the Date of Substantial Completion of the Project and the end of the guarantee period becomes less than eleven (11) months, the start of the guarantee period shall be the date of the final Project Certificate of Payment in lieu of the Date of Substantial Completion of the Project

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the State of New Jersey and any dispute regarding the Contract shall be venued in Superior Court of New Jersey, Essex County.

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§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Construction Manager, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Construction Manager and Architect timely notice of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.4.2 If the Construction Manager, Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Construction Manager and Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Construction Manager and Architect of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Construction Manager's and Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager for transmittal to the Architect.

§ 13.4.5 If the Construction Manager or Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Construction Manager or Architect will do so promptly and, where practicable, at the normal place of testing. The Architect or Owner may require evidence that materials comply with the Contract. No inspection or approval relieves the Contractor of obligations unless the Owner expressly agrees in writing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

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§13.4.6.1 Inspections and Tests required to establish with the Contract Documents and specified to be "by Owner", will be made by an independent testing agency selected and paid for by the Owner. Re-testing required as a result of first test showing non-compliance with the Contract Documents will be performed by the same agency, with costs paid for by the Contractor. Representatives of the testing agency shall have access to the Work at all times. The Contractor shall provide facilities for such access in order that the agency may properly perform its function.

§13.4.6.2 The independent agency employed by the Owner shall prepare the test reports, logs and certificates applicable to the specific inspection and test, and promptly deliver the specified number of copies of same to the designated parties. Other required certificates of inspections, testing or approval shall be secured by the Contractor and delivered by him to the Construction Manager and/or Owner's Representative, in such time as not to delay progress of the Work or final payment thereof.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located. Notwithstanding, any payments withheld for time delays, faulty materials, or workmanship, shall not bear interest for period of delay or non-acceptance.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, their agents or employees, or any other persons performing portions of the Work under contract with the Contractor because any order of any Court or other public authority having jurisdiction, an act of government, such as a declaration of national emergency, that requires all Work to be stopped; or because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made approved payments on a Certificate for Payment within the time stated in the Contract Documents, the Contractor may, upon seven (7) additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work properly executed only.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- **.1** refuses or fails to supply adequate and competent supervision of properly skilled workers or proper quality or quantity of materials, or falls in any respect to prosecute the Work with promptness and diligence;
- **.2** fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- **.3** disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 disregards the instructions of the Owner, when such instructions are based on the requirement of the Contract Documents;
- .5 is adjudged a bankrupt or insolvent, or makes a general assignment for the benefit of the Contractor's creditors, or a trustee or receive is appointed for Contractor or any of its property, or files a petition to take advantage of any debtor's act, or to reorganize under bankruptcy or similar laws;
- **.**6 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with the requirements of the Contract Documents
- **.**7 Breaches any warranty made by the Contractor under or pursuant to the Contact Documents;**.8** otherwise does not comply with the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, after consultation with the Construction Manager, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the

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Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the costs of finishing the Work, including compensation for the services of any consultants and the Architect's services and expenses made necessary thereby, and the other costs and expenses identified hereinafter, exceed the unpaid balance of the Contract Sum, the Contractor shall pay the difference to the Owner upon demand. The costs of finishing the Work include, without limitation, all reasonable attorney's fees, additional title costs, insurance, additional interest because of any delay in completing the Work and all other damages as contemplated by this Agreement, incurred by the Owner by reason of or arising from, or relating to the termination of the Contractor as stated herein. .

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and the Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

Notwithstanding, the Contractor is required to continue performing those portions of the work not suspended by the Owner, as refusal to continue the work not suspended constitutes a breach of contract on the part of the Contractor.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed up to the date of the termination in accordance with the Contract Documents; reasonable costs incurred by reason of the termination as determined by Owner, including reasonable documented costs attributable to termination of Subcontracts – mitigated by the Contractor and subject to Owner approval. The Contractor shall, as a condition of receiving the payments referred to herein, execute and deliver all such papers, turn over all plans, documents and files of whatsoever nature required by the Owner, and take all such steps, including the legal assignment of its contractual rights, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor. Any claims or damages presented by subcontractors, suppliers, or other parties under contract with the Contractor, arising from or in connection with the termination for the Owner's convenience, shall be the sole responsibility of the Contractor. The Owner shall not be liable for, and the Contractor shall not be entitled to claim or recover, the following costs or damages associated with the termination: (a) Loss of anticipated profits or consequential damages; (b) Costs related to the Contractor's general overhead or home office expenses; (c) Costs

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incurred after the effective date of termination; (d) Costs that are not directly attributable to the termination or those lacking proper documentation.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Construction Manager and Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, or disputed item of work, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost. If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4. The foregoing written notice shall contain a written statement from the Contractor setting forth in detail the nature and cause of the Claim and an itemized statement of the increase requested to the extent that such costs are reasonably available to the Contractor and accurate. No such written notice shall form the basis of an increase to the Contract Sum unless and until such increase has been authorized by a written Change Order executed and issued according to the terms and conditions set forth herein.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. Said notice shall itemize all claims and shall contain sufficient detail and substantiating data to permit evaluation of same by the Owner and Architect. No such claim shall be valid unless so made The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

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§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

Where the cause of delay is due to the weather conditions, extension of time shall be granted only for unusually severe weather, as determined by reference to historical data. The term "historical data" as used in the preceding sentence shall be construed according to this formula: Average rainfall (or snow, or extreme low temperature) for the past five (5) years for the month in question, plus twenty (20) percent. In other words, weather is not deemed to be unusually severe unless it is twenty (20) percent worse than the average for that month over the last five (5) years. Notwithstanding, weather events may include those days in which the Contractor is unable to proceed with work on the critical path for more than seven (7) continuous normal Work hours in a day.

§ 15.1.7 Waiver of Claims for Consequential Damages. The Contractor waive Claims against the Owner for consequential damages arising out of or relating to this Contract. This waiver includes damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This waiver is applicable, without limitation, to all consequential damages due to termination by the Owner in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties, the Construction Manager, and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

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§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days of receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, 15.1.7 and 16.2.6.1, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by a retired Judge of the Superior Court of New Jersey mutually agreed to by the parties. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

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SECTION 00800 - SUPPLEMENTARY GENERAL CONDITIONS

PART 1 - GENERAL

1.1 FUNCTION

A. The following supplements modify, change, delete from or add to the "General Conditions of the Contract for Construction, Construction Manager as Adviser Edition", AIA Document A232 - 2019 and the Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, AIA Document A132 - 2019. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these supplements, the remaining unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

B. Refer to Sections in Division 1 "General Requirements" for additional modifications, deletions and additions to the "General Conditions of the Contract for Construction".

1.2 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, CONSTRUCTION MANAGER AS ADVISER EDITION, AIA DOCUMENT A232-2019.

A. Document is modified in accordance with the following paragraphs and as indicated herein after:

1.3 PARAGRAPH 1.1 - BASIC DEFINITIONS

A. Paragraph 1.1.1 - "The Contract Documents":

Delete last sentence "Unless specifically enumerated in the Agreement, the Contract Documents do not..... proposal requirements)."

B. Supplement Paragraph 1.1 "Basic Definitions", as follows:

1.1.11 The Project Manual. The Project Manual is a volume, or volumes, assembled for the Work that includes, or is deemed to incorporate by reference the General Conditions, Supplementary Conditions, the Bidding Requirements and Documents related thereto, the Specifications, and all Addenda issued prior to the execution of the Contract."

1.1.12 Final Completion. The date the Contract has been fully performed, all the Work has been completed and a final certificate for Payment approved by the Owner has been issued by the Architect.

1.1.13 Or Approved Equal and Equal To. Shall mean products by manufacturers other than those specified in the Contract Documents in which the Contractor may submit for those specified in the Contract Documents and which may be

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incorporated in the Work after review and acceptance by the Architect and acceptance by the Owner.

1.4 PARAGRAPH 1.2 - CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

A. Delete Paragraph 1.2.1 in its entirety and substitute with the following:

1.2.1 The Contract Documents include all items necessary for the proper execution and completion of the Work by the Contractor. The Work shall consist of all items specifically included in the Contract Documents as well as all additional items of Work which are reasonably inferable from that which is specified in order to complete the Work in accordance with the Contract Documents. The Contract Documents are complementary, and what is required by any one Contract Document shall be as binding as if required by all. Any differences between the requirements of the Drawings and the Specifications or any differences noted within the Drawings themselves or within the Specifications themselves have been referred to the Owner, Architect and Construction Manager by Contractor prior to the submission of bids and have been clarified by an Addendum issued to all Bidders.

If any such differences or conflicts were not called to the Owner's, Construction Manager and the Architect's attention prior to submission of bids, the Architect shall decide which of the conflicting requirements will govern based upon the most stringent of the requirements, and, subject to the approval of the Owner, the Contractor shall perform the Work at no additional cost and/or time to the Owner in accordance with the Architect's decision. Work not covered in the Contract Documents will not be required unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce the intended results.

1.5 PRECEDENCE OF LARGE SCALE DETAILS

A. Supplement Paragraph 1.2 "Correlation and Intent of the Contract Documents", as follows:

1.2.4 The general character of the detail Work is shown on the Drawings but minor modifications may be made in large scale details in accordance with N.J.A.C. 6A:23A-21.1. Where the word "similar" occurs on the Drawings it shall be used in its general sense and not as meaning identical, and all details shall be worked out in relation to their location and their connection to other parts of the Work. Where on any Drawings a portion of the Work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to other like portions of the Work. Where detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts in the Work unless otherwise indicated. In case of differences between small and large scale Drawings, the larger scale Drawings shall take precedence. Dimensions given shall take precedence over scale measurements. Any discrepancies shall be referred to the Architect for adjustment before any Work affected thereby has been performed.

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1.2.5 During the course of the Work, should any ambiguities or discrepancies be found in the Specifications or on the Drawings; or should there be found any discrepancies between the Drawings and Specifications to which the Contractor has failed to call attention before submitting their bid, then the Architect will interpret the intent of the Drawings and Specifications and the Contractor hereby agrees to abide by the Architect's interpretation and to carry out the work in accordance with the decision of the Architect. It is expressly stipulated that neither the Drawings nor the Specifications shall take precedence over the other, and it is further stipulated that the Architect may interpret or construe the Drawings and Specifications so as to secure in all cases the result most consistent with the needs and requirements of the Work, and which is in the best interests of the Owner.

1.6 PARAGRAPH 2.1 - GENERAL

A. Delete Paragraph 2.1 in its entirety.

1.7 PARAGRAPH 2.2 - EVIDENCE OF THE OWNER'S FINANCIAL ARRANGEMENTS

A. Delete Paragraph 2.2 in its entirety.

1.8 PARAGRAPH 2.2 - INFORMATION AND SERVICES REQUIRED OF THE OWNER

A. Delete Paragraph 2.3.7 in its entirety and substitute with the following:

2.3.7 The Architect will furnish the Contractor, without charge, the following number of sets of Drawings and Specifications. Additional copies will be furnished at the Architect's reproduction costs, to be paid by the Contractor.

Single Overall Contract 3 Sets

1.9 PARAGRAPH 2.4 - OWNER'S RIGHT TO STOP THE WORK

A. Edit paragraph 2.4 as follows:

Line 3; after "Documents" add:

"or fails or refuses to provide a sufficient amount of properly supervised and coordinated labor, materials, or equipment so as to be able to complete the Work within the Contract Time or fails to remove and discharge (within ten days) any lien filed upon Owner's property by anyone claiming by, through, or under Contractor, or disregard the instructions of Architect, Construction Manager or Owner when based on the requirements of the Contract Documents,".

1.10 PARAGRAPH 2.5 - OWNER'S RIGHT TO CARRY OUT THE WORK

A. In the 11th line, delete "the Contractor....to the Owner", and substitute with the following:

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"the Contractor, and/or their Surety shall pay the difference to the Owner."

1.11 PARAGRAPH 3.2 - REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

A. Delete the second sentence in Paragraph 3.2.2 in its entirety and substitute with the following:

"If any errors, inconsistencies or omissions appear in the Drawings, Specifications or other Contract Documents, which should reasonably have been discovered and concerning which interpretation had not been obtained from the Architect during the Bidding Period, the Contractor shall within ten days after receiving written 'Notice of Award' notify the Architect in writing of such error, inconsistency or omission. In the event the Contractor fails to give such notice, they will be held responsible for the results of any such errors, inconsistencies or omissions and the cost of rectifying same. Interpretation of this procedure after the ten-day period will be made by the Architect and their decision will be final".

1.12 LAYOUT OF WORK

A. Supplement Paragraph 3.3 "Supervision and Construction Procedures", as follows:

3.3.4 Each Contractor shall lay out their own Work and be responsible for all lines, elevations and measurements of the building, and other Work executed by them under the Contract. They must exercise proper precaution to verify the figures shown on the Drawings before laying out the Work and will be held responsible for any errors resulting from their failure to exercise such precaution.

3.3.5 The Contractor shall coordinate their operations with those of all their Subcontractors.

3.3.6 The Contractor, including their Subcontractors, shall keep fully informed of the progress and the details of the Work of all Subcontractors, and shall notify the CM immediately of lack of progress or defective workmanship on the part of any Subcontractors.

3.3.7 Failure of the Contractor to keep informed of the Work progressing on or off the site, and their failure to give notice of lack of progress of defective workmanship by others, will be construed by Owner and by the CM as acceptance by the Contractor of the status of the Work as being satisfactory for proper coordination with the Contractor's own Work and with the Work of all their Subcontractors.

1.13 WARRANTY

A. Supplement Paragraph 3.5 "Warranty", as follows:

3.5.1.1 The warranty period for all work of each Contractor shall be **two (2) years**

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from the date of substantial completion and acceptance by the Owner unless otherwise specified.

1.14 PARAGRAPH 3.7 - PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

A. 3.7.3 In line 3, delete "the costs attributable to correction" and replace with "all costs attributable to the correction thereof or related thereto, including all fines and penalties."

1.15 PARAGRAPH 3.9 - SUPERINTENDENT

A. Supplement Paragraph 3.9 "Superintendent", as follows:

3.9.2.1 Qualifications of superintendent proposed to be used shall be submitted to the Construction Manager and Owner's approval obtained before proceeding with the Work.

3.9.5 The superintendent shall be assigned to the project on a full-time basis from the inception of construction until the completion of all corrective and punch list Work.

1.16 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

A. Supplement Paragraph 3.10 "Contractor's Construction Submittal Schedules", as follows:

3.10.1.1 Within fifteen (15) days after the date of the Notice to Proceed the Contractor shall submit to the Architect, on forms supplied by the Architect, a bar-graph Progress Schedule upon which shall be indicated the dates for starting and the dates for completion of the Contract and all divisions of the Work in a manner which will coincide with Time For Completion and other project milestone dates.

Schedule "CPM" Requirements:

.1 General Construction Work Contractor shall include in their price the cost of the outsourcing CPM scheduling for entire project and all prime Subcontractors. Utilize "Primavera-Project Planner - current version Software by Primavera Systems Inc.".
.2 CPM consultant to be approved by Architect and the Construction Manager. Initial GC. Schedule to be provided to all Prime Subcontractors within 15 days of Notice to Proceed.
.3 Monthly updates will be required during construction with each payment application.
.4 Interim Progress Updates will be required for each Job Progress Meeting.
.5 Comply with all recommendations and instructions of the Construction Manager for preparation of Project Schedule and associated periodic reports.

3.10.1.2 This schedule will be distributed to the Prime Subcontractors for Structural Steel, Plumbing, Heating, Ventilating and Air Conditioning and Electrical Work. When

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approved by the Subcontractors and agreed upon by the Architect, this schedule will become one of the Contract Documents, and shall be altered thereafter only in accordance with duly authorized change orders for extensions of time in accordance with Paragraph 8.3, "Delays and Extensions of Time".

1.17 SUBMITTALS

A. Supplement Paragraph 3.12 "Shop Drawings, Product Data and Samples", as follows:

3.12.11 All fabricated Work shall require shop drawings.

3.12.13 The Architect may request samples of any or all materials to be used in the Work. When requested, samples shall be submitted promptly.

3.12.14 Shop drawings and other data, where possible, shall be submitted in the form of reproducible transparency. Catalogs and other printed matter shall be submitted in six (6) copies.

.1 Additional prints for file, distribution and for coordination of the work with other Contractors shall be provided as directed or as required.

3.12.15 Submittal Procedures: The Contractor's failure to follow proper procedures for submittals constitutes grounds for withholding of payments until such time as the Contractor is in compliance. Proper submittal procedures include all of those set forth elsewhere in this Specification including the following:

.1 All submittals shall be separate for each Project. Contractor must indicate on each transmittal the reference to the Architect's Project Number.
.2 Failure to adhere to deadlines for completion of submittals and record/resubmittals.
.3 Failure to provide submittals in good order as required by the Contract Documents.
.4 Failure to provide submittals in relationship to the progress of the Work.
.5 Performance of Work or part of the Work, without complete approved submittals.

3.12.16 Architect / Engineer's actions for submittals shall be as follows:

.1 Submittals returned to the Contractor marked "Approved" allow the Contractor to proceed with the work.
.2 Submittals returned to the Contractor "Approved As Noted"; "Resubmit For Record":
  .1 The Contractor may proceed with work, however noted items by the Architect / Engineer (or any affected portion of the submittal), must be corrected and resubmitted to the Architect's office within ten (10) working days of Contractor's receipt of the original submittal. Final acceptance of all work is subject to the Contractor's compliance with requirements of the Contract Documents.
.3 Submittals returned marked "Returned for Corrections" require the Contractor to resubmit corrected or alternate data in accordance with the corrections

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indicated.

.1 The originals of the reproducible transparencies marked "Returned for Corrections" shall be corrected until approval is obtained. The Contractor shall provide such number of prints of transparencies marked "Approved" as required for the expeditious execution of the Work.

.4 Submittals returned marked "No Action Taken":

.1 The Contractor may not proceed with the Work. The Architect / Engineer will not review submittals so marked until the Contractor has properly completed the submittal or corrected the reasons stated thereon.

.2 Reasons for "No Action Taken" on a submittal include, but are not limited to the Contractor's failure to:

.1 Submit an approved Subcontractor or supplier.

.2 Indicate job specific product data such as catalog number, size, type or material on each submittal.

.3 Submit complete data, test reports or similar information as required by the Contract Documents.

.4 Obtain prior approval for substitution.

.5 Submit documents in a legible or orderly fashion.

.6 Adhere to any submittal requirements set forth in the Contract Documents.

.7 Submit only submittals which are called for in the Contract Documents, other submittals will not be reviewed by the Architect / Engineer.

3.12.17 The following submittal schedule will be mandatory; time is from date of the Notice to Proceed, in consecutive calendar days and also in accordance with requirements of Specification Section 01800.

The Contract and Trades: 30 days

3.12.18 Request for Substitutions:

.1 Substitutions may be considered Only within thirty (30) calendar days after the award of the Contract. Subsequent requests will be considered Only when, through no fault of the Contractor or any other persons for whom Contractor is responsible, none of the specified products are available.

.2 Submission of request for substitution shall constitute a representation by the Contractor that they:

.1 Have investigated the proposed product and determined that it is equal to or better than the specified product.

.2 Will provide the same variety for the proposed product as for the specified product.

.3 Will coordinate the installation and make other changes which may be required for the Work to be complete in all respects, including:

.1 Re-design.

.2 Additional components and capacity required by other Work affected by the change.

.3 Waives all claims for additional costs and time extensions which

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subsequently may become apparent and which are caused by the change.

.4 Will reimburse the Owner for additional costs for evaluation of the substitution request, re-design if required, and re-approval by Authorities Having Jurisdiction if required.

.3 Substitutions will not be considered when acceptance would require substantial revision of the Contract Documents.

.4 Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without separate written request.

.5 Substitution requests will not be considered when submitted directly by Subcontractor or supplier.

.6 When the proposed substitution is not accepted, Contractor(s) must provide the product (or one of the products, as the case may be) specified.

.7 The Contractor will be notified in writing within a reasonable time, verbal acceptance will not be valid.

.8 Acceptable substitutions will be added to the Contract Documents by appropriate modifications.

.9 Requests for substitution will be reviewed by the Architect upon receipt of all the information requested in the following paragraph. Failure to provide the required information shall be cause for rejection of substitution request.

.10 Submittal for Substitutions:

.1 Submit 3 copies of requests for substitutions, fully identified for product, material or method being replaced by substitution, including related Specification section and Drawing number(s), and fully documented to show compliance with requirements for substitutions. Submit the following:

.1 Complete product data, Drawings, and descriptions of materials and methods where applicable. Provide manufacturer's name and address, trade name, and model number of product (if applicable), and name of fabricator or supplier (if applicable).

.2 Samples where applicable or requested.

.3 Detailed comparison of significant qualities (size, weight, durability, performance and similar characteristics, and including visual effect where applicable) for proposed substitution in comparison with original requirements.

.4 List, with addresses, of 3 projects where proposed substitution has been used previously and successfully in a similar application.

.5 Coordination information, indicating every required change in every other element of the work which is affected by substitution, extended to include work by Owner and separate Contractors.

.6 A complete statement of effect substitution will have upon schedule of the Work, including its effect (if any) on Contract time (in comparison with compliance with requirements without approval of proposed substitution).

.7 Cost information, including a proposal of net change in Contract Sum (if any).

.8 Certification by Contractor to the effect that, in their opinion and after

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their thorough evaluation, proposed substitution will result in total Work which is equal to or better than the Work originally required by Contract Documents, in every respect of significance except as specifically stated in certification; and that it will perform adequately in application indicated, regardless of equality and exceptions thereto.

.9 Include in certification, Contractor's waiver of rights to additional payment and time which may subsequently be necessitated, by failure of substitution to perform adequately and for required Work to make corrections thereof.

3.12.19 Approval of Substitutions:

.1 Pursuant to N.J.S.A. 18A:18A-15(d), requests for substitutions, for a requested approved equal product, will be reviewed for compliance with the Specifications based upon the data provided by the Contractor after the award of the project. Approval or rejection will be based on samples, technical data and other items submitted and will be reviewed once and only once for each such request.

.2 Change Order Form: Submit requests for substitutions which propose a change in either the Contract Sum or Contract Time by procedures required for change order proposals.

3.12.20 "Or Equals"

A. Contractor's Request; Governing Criteria: Whenever an item of equipment or material is specified to described in the Contract Documents by using the names of one or more proprietary or items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The Specification or description of such an item is intended to establish the type, function, appearance, and quality required. To the extent allowable by N.J.S.A. 18A:18A-15(d) and unless the Specification or description contains or is followed by words reading “proprietary item”, no like, equivalent, or "or equal" item is permitted, Contractor may request that the Architect authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

B. If the Architect, in its sole discretion, determines that an item of equipment or material proposed by the Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, the Architect will deem in an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

C. In the exercise of reasonable judgment, Architect determines that the proposed item:

1. Is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

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2. Will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
3. Has a proven record of performance and availability of responsive service.

D. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
1. There will be no increase in cost to the Owner or increase in Contract Times; and
2. The item will conform substantially to the detailed requirements of the item named in the Contract Documents.

E. Contractor's Expense: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

F. Architect's Evaluation and Determination: Architect will be allowed a reasonable time to evaluate each "or equal" request. Architect may require Contractor to furnish additional data about the proposed "or equal" item. Architect will be the sole judge of acceptability. No "or equal" item will be ordered, furnished, installed or utilized until Architect's review is complete and Architect determines that the proposed item is an "or equal," which will be evidence by an approved Shop Drawing or other written communication. Architect will advise Contractor in writing of any negative determination.

G. Effect of Architect's Determination: Neither approval nor denial of an "or equal" request will result in any change in Contract Price. The Architect's denial of a submitted n "or equal" request, and the subsequent rejection based on the evaluation of the submitted product data is not equivalent to the Basis of Design will be final and binding, and may not be reversed through an appeal under any provision of the Contract in a manner consistent with N.J.S.A. 18A:18A-15(d).

H. Treatment as a Substitution Request: If Architect determines that an item of equipment or material proposed by Contractor does not qualify as an "or equal" item, Contractor may request that the Architect consider the item a proposed substitute pursuant to 3.12.17.

1.18 LONG LEAD ITEMS

A. Supplement Paragraph 3.12 "Shop Drawings, Product Data and Samples", as follows:

3.12.19 In addition to and concurrent with the submission of the "Schedule of Values" as provided under Paragraph 9.2, Contractor shall submit a list of all materials, equipment or components which are anticipated to require more than four weeks delivery, together with scheduled ordering and delivery time table. This will be discussed and reviewed regularly at the job site meetings. Upon request by the

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Architect, the Contractor shall be prepared to produce evidence of having placed orders for specific materials, equipment and components.

1.19 PARAGRAPH 3.13 - USE OF SITE

A. Supplement Paragraph 3.13 “Use of Site”, as follows:

3.13.9 Only materials and equipment which are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the project site. Protection of construction materials and equipment stored at the project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

3.13.10 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the project site without the prior written consent of the Owner.

1.20 CLEANING UP

A. 3.15.1 In line 2, insert "promptly" before "remove." In the last line, add "in addition, the Contractor shall comply with 3.15.4."

B. 3.15.2 In the last line, add ",and withheld from any remaining payments."

C. Supplement Paragraph 3.15 “Cleaning Up”, as follows:

3.15.3 The Contractor shall frequently clean up all refuse, rubbish, scrap, cartons, materials and debris caused by construction operations to the end that the site of the Work shall at all times present a neat, orderly and workmanlike appearance. This includes, without exception, the debris created by the work of all Trades engaged under the Contract. The Contractor shall remove the debris from the site and premises and dispose of it by legal means at its own expense for collecting, loading, hauling and dumping.

3.15.4 The Prime Contractor shall also perform or have performed the following immediately prior to the Architect's inspection for Substantial Completion:

.1 Removal of all manufacturer's temporary labels from materials, equipment and fixtures.
.2 Removal of all stains from glass and mirrors; wash, polish, inside and outside.
.3 Removal of marks, stains, fingerprints, other soil, dust, dirt, from painted, decorated or stained woodwork, plaster or plasterboard, metal, acoustic tile, and equipment surfaces.
.4 Removal of spots, plant, soil from resilient flooring.
.5 Removal of temporary floor protections, clean, wax or otherwise treat as directed, polish all finished floors. Final vacuum all carpet.
.6 Clean all interior finished surfaces, including doors and window frames and hardware required to have a polished finish, of oil, stains, dust, dirt, paint and the like; leave without fingerprints, blemishes.

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.7 Final site clean-up shall extend beyond the Contract Limit Lines as reasonably required to insure the complete removal of all construction debris from the/ each entire site, including staging areas.

1.21 PARAGRAPH 3.16 - ACCESS TO WORK

A. Supplement Paragraph 3.16 “Access to Work”, as follows:

3.16.1 The Contractor shall promptly notify the Architect and Construction Manager and Owner of the presence of hazardous conditions at the / each site, including the start of hazardous operations or the discovery or exposure of hazardous substances.

1.22 PARAGRAPH 3.18 - INDEMNIFICATION

A. Supplement Paragraph 3.18.1, “Indemnification”, as follows:

.1 Contractor, for itself, its successors and assigns, agrees to indemnify and save Owner, the individual members (past, present and future), its successors, assigns, employees, agent, Architect(s), Engineer(s), and the Construction Manager, harmless from, and against any and all claims, demands, damages, actions or causes of action together with any and all losses, costs or expenses in connection therewith or related thereto, including, but not limited to, attorney fees and costs of suit, for bodily injuries, sickness, disease, death or property damage arising in or in any manner growing out of the Work performed, or to be performed under this Contract. Contractor and its successors and assigns agree to indemnify the Owner, its individual members (past, present and future), its successors, assigns, employees, agents, Architect(s), Engineer(s) and/or Construction Manager against all fines, penalties or losses incurred for, including, but not limited to, attorney fees and costs of suit, or by reason of the violation by Contractor in the performance of this Contract, or any ordinance, regulation, rule of law of any political subdivision or duly constituted public authority. Without limiting the foregoing, the Contractor, at the request of Owner, its individual members (past and present), its successors, assigns, employees, agents, Architect(s), or Engineer(s) and Construction Manager, agrees to defend at the Contractor's expense any suit or proceeding brought against Owner, its individual members (past, present and future), its successors, assigns, employees, agents, Architect(s), Engineer(s) and /or Construction Manager, due to, or arising out of the Work performed by the Contractor.
   .1 Contractor acknowledges and agrees that obligations and duties of the Construction Manager under the Construction Manager's agreement with the Owner are solely for the benefit of the Owner, that notwithstanding any action of the Construction Manager in connection with the Project.
   .2 The Construction Manager shall not in any respect be deemed to have assumed any duties or obligations in favor of the Contractor, and that Construction Manager is acting as an agent of and on behalf of the Owner to the extent provided herein.

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1.23 RE-DESIGN

A. Supplement Article 3 "Contractor", as follows:

3.19 RE-DESIGN

If the Contractor makes, or causes to be made, due to approval of substitute equipment or otherwise, any substantial change in the form, type, system and details of construction from those shown on the Drawings, they shall pay for all costs arising from such changes. The Contractor shall pay all Architectural and Engineering fees required to check the adequacy of such changes. Any changes or departures from the construction and details shown shall be made only after written approval from the Architect.

1.24 PARAGRAPH 4.2 - ADMINISTRATION OF THE CONTRACT

A. Supplement Paragraph 4.2.1, as follows:

.1 The Owner has designated New Road Construction Management as Construction Manager, authorized to act in the Owner's behalf to administer, coordinate, and inspect the Work of this Project.

.1 Any and all correspondence, coordination, questions and instructions will be directed to and issued by the Construction Manager to all project participants.

B. 4.2.3 In lines 2 and 3, delete "determine in general" and replace with “endeavor to determine”.

C. 4.2.4 In the 1st line, change "Construction Manager" to "Prime Contractor".

D. 4.2.10 In this Paragraph, change all references "Construction Manager" to read "Architect" and change "Architect" to read "Construction Manager".

E. 4.2.13 After "Construction Manager" add words "and the Architect".

F. Supplement Paragraph 4.2 "Administration of the Contract", as follows:

4.2.22 Reference in the technical provisions of the Specifications to standard Specifications and test methods, including those of the American Society for Testing and Materials, the American Iron and Steel Institute, the American National Standards Institute, the American Society of Mechanical Engineers, the American Society of Heating, Refrigeration and Air Conditioning Engineers, the Factory Mutual System, the National Fire Protection Association, Federal Specifications, and other similar nationally recognized technical societies and agencies shall refer to the editions and revisions current with the date of the Contract Documents.

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"Any claim, dispute or other matter in question between the Contractor and the Owner referred to the Architect through the Construction Manager, except those relating to the artistic effects as provided in subparagraph 4.2.20 and those which have been waived by the making or acceptance of final payment as provided in subparagraph 9.10, inclusive, may proceed to litigation, but not before the earlier of (1) the date on which the Architect has rendered a written decision, or (2) the tenth day after the parties have presented their evidence to the Architect or have been given a reasonable opportunity to do so, if the Architect has not rendered a written decision by that date. No such claim may proceed to arbitration."

4.2.23 The Architect's decision, after consultation with Owner and Construction Manager with respect to proposed substitutions of material or equipment specified by trade name, shall be final. The Architect reserves the right, after consultation with Owner and Construction Manager, to waive Specifications and to accept a proposed substitution which in their opinion is superior to the material or product specified, or to limit the Specification to the product specified.

4.2.24 Where three or more trade names or manufacturers' names are specified, the Contractor shall furnish one of the brands specified or may submit an equivalent or better product(s) to be reviewed by the Architect / Engineer for consideration. Where only one brand or name is specified, the Contractor may submit other brands for consideration; however, it shall be the Contractor's responsibility to prove equality.

4.2.25 Approval of substitutions shall not relieve the Contractor of responsibility for adequate fulfillment of all the various parts of the work, nor from specified guarantees and maintenance. Modification of adjacent or connecting work required due to any substitution approval shall be provided as part of the substitution.

4.2.26 Insofar as practicable, except as otherwise specified or shown, the material or product of one manufacturer shall be used throughout the work for each specified purpose.

4.2.27 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in strict accordance with the manufacturer's directions. Should such directions conflict with the Specifications, the Contractor shall request clarification from the Architect before proceeding.

1.25 SUBCONTRACTORS AND MATERIALMEN

A. Delete subparagraph 5.2.3 and substitute with the following:

5.2.3 The names of all Subcontractors and material suppliers, in addition to those required to be listed pursuant to N.J.S.A. 18A:18A-18 (if any), shall be submitted with the Contractors bid proposal. Subcontractors referenced herein, are in addition to those required to be listed, along with all necessary paperwork concerning each such Subcontractor’s qualifications, licensure, etc., pursuant to N.J.S.A. 18A:18A-18, if any. The list of proposed Subcontractors shall include a description of the materials and

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equipment each proposes to furnish and install in the work. The description shall be in sufficient detail to allow the Architect to determine general conformance to Contract requirements. Approval of the submittals required under this Article shall not relieve the Contractor from conformance to Contract requirements.

B. Supplement subparagraph 5.2.3, as follows:

.1 Written confirmation of award of each major Subcontract shall be submitted to the Architect, in form subject to their approval, within seven (7) calendar days after receipt of Architect's approval of proposed Subcontractor list as provided under Paragraph 5.2.3 above.

1.26 PARAGRAPH 5.3 - SUBCONTRACTUAL RELATIONS

A. 5.3 At lines 5, 10, 11, and 13, insert “written” before the word “agreement” or “agreements”

B. Supplement Paragraph 5.3, as follows:

5.3.1 The Contractor shall obligate the/each Subcontractor specifically to comply with the New Jersey Plan of Affirmative Action to avoid discriminatory practice in employment.

5.3.2 The Contractor shall obligate the/each Subcontractor to comply with the applicable prevailing wage schedule of the Department of Labor of the State of New Jersey.

5.3.3 The Contractor agrees that all of its Contract(s) with Subcontractor(s) shall have provisions requiring that the Subcontractor(s) comply with the provisions of the New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq.

1.27 PARAGRAPH 6.1 - OWNER’S RIGHT TO PERFORM CONSTRUCTION WITH OWN FORCES AND TO AWARD OTHER CONTRACTS

A. Delete subparagraph 6.1.2 in its entirety and substitute with the following:

6.1.2 The Prime Contractor shall provide for the coordination of the Work of their own forces and of each of their separate Subcontractors with Work of the other Contractors, who shall cooperate therewith as provided in Paragraph 6.2.

1.28 PARAGRAPH 6.2 - MUTUAL RESPONSIBILITY

A. 6.2.4 In line 1, delete "wrongfully."

B. Supplement Paragraph 6.2.4, as follows:

.1 Should the Contractor cause damage to the Work or property of any separate Contractor on the project, the Contractor shall, upon due notice,

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promptly settle with such other Contractor by agreement or otherwise resolve the dispute. If such separate Contractor sues or institutes an arbitration proceeding against the Owner on account of any damage alleged to have been so sustained, the Contractor shall defend such proceeding at their own expense, and if any judgment against the Owner arises therefrom, the Contractor shall pay or satisfy it and shall reimburse the Owner for any attorney's fees and court costs which the Owner has incurred.

1.29 ARTICLE 7 - CHANGES IN THE WORK

A. Supplement Paragraph 7.1 “General”, as follows:

7.1.2 Add to the end of Subparagraph 7.1.2, "Neither this Contract nor the Work to be performed hereunder can be changed by oral agreement. No course of conduct or dealings between the parties, nor express or implied acceptance of alterations or additions to the Work, and no claims that the Owner has been unjustly enriched by any alteration or addition to the Work, whether there is, in fact, any unjust enrichment to the Work, shall be the basis for any alleged implied agreement by the Owner to the change or any increase in any amounts due under the Contract or a change in any time period provided for in the Contract Documents."

7.1.2.1 A field directive or field order shall not be recognized as having any impact upon the Contract Sum or the Contract Time and the Contractor shall have no claim in regard thereto unless it shall, prior to complying with same and in no event no later than 10 business days from the date such direction or order was given, submit to the Owner for the Owner's approval its change proposal.

B. Supplement Paragraph 7.2 “General”, as follows:

7.2.2.2 When submitting its change order, the Contractor shall include and set forth in clear and precise detail breakdowns of labor and materials for all Trades involved and the estimated impact on the construction schedule. The Contractor shall furnish spread sheets from which the breakdowns were prepared, plus spread sheets, if requested, of any Subcontractors.

1.30 ALLOWANCE FOR CHANGE ORDER OVERHEAD AND PROFIT

A. Supplement Paragraph 7.2 "Change Orders" as follows:

7.2.4 For any extra Work or portion thereof performed by the Prime Contractor, the cost to the Owner shall include the cost of the extra work plus a maximum allowance of fifteen percent (15%) for overhead and profit.

.1 For any extra Work or portion thereof performed by a Subcontractor(s), the cost to the Owner shall include the cost of the extra work to the Subcontractor plus a maximum allowance of ten percent (10%) for overhead and profit, plus the Prime Contractor's overhead and profit not to exceed five percent (5%) of the Subcontractor's cost.

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7.2.5 Change Order shall include all costs, including cost of preparation of the change order, all impact and ripple costs associated with modifications or delays to the Work, and all costs associated with modifications to other Work.

.1 The Prime Contractor shall furnish all necessary documentation to support the additional cost, including but not limited to the following:

.1 Copy of Subcontractor's proposal.

.2 Complete breakdown for all costs for labor and material.

.3 Complete breakdown of related costs.

.4 Other information as may be requested by the Architect / Construction Manager.

7.2.6 The overall cost of the Change Order shall be inclusive and once accepted by the Owner it shall be considered full and final.

7.2.7 No additional time will be granted to the Contractor for minor change orders unless each individual change order totals more than $100,000.

7.2.8 A field directive or field order shall not be recognized as having any impact upon the Contract Sum or the Contract Time and the Contractor shall have no claim in regard thereto unless it shall, prior to complying with same and in no event no later than 10 business days from the date such direction or order was given, submit to the Owner for the Owner's approval its change proposal.

7.2.9 When submitting its change proposal, the Contractor shall include and set forth in clear and precise detail breakdowns of labor and materials for all trades involved and the estimated impact on the construction schedule. The Contractor shall furnish spread sheets from which the breakdowns were prepared, plus spread sheets, if requested, of any Subcontractors.

1.31 PARAGRAPH 8.2 - PROGRESS AND COMPLETION

A. 8.2.2 Delete "knowingly" in line 1.

1.32 TIME OF COMMENCEMENT

A. Supplement Paragraph 8.2 "Progress and Completion", as follows:

8.2.4 Work shall commence within ten (10) business days from the date of the Notice to Proceed (NTP).

1.33 EXTENSION OF TIME

A. Supplement Paragraph 8.3 "Delays and Extensions of Time", as follows:

8.3.5 Where the cause of delay is due to weather conditions, extension of time shall be granted only for unusually severe weather, as determined by reference to historical data. The term "historical data" as used in the preceding sentence shall be construed

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according to this formula: Average rainfall (or snow or low temperature) for the past five (5) years for the month in question, plus 10 percent. In other words, weather is not deemed to be unusually severe unless it is more than 10 percent worse than the average for that month over the last five years.

8.3.6 If the Contractor is delayed in completion of the work by any act or neglect of the Owner, Architect, or of any other Contractor employed by the Owner, or by changes ordered in the Work, or by strikes, lockouts, fire, unusual delay by common carriers, unavoidable casualties, or any cause beyond the Contractor's control or by any cause which the Architect / Construction Manager shall decide to justify the delay, then for all such delays and suspensions the Contractor shall be allowed one day additional to the time limitations herein stated for each and every day of such delay so caused in the completion of the work, the same to be ascertained solely by the Architect / Construction Manager, and a similar allowance of extra time will be made for such delays as the Architect / Construction Manager may find to have been caused by the Owner.

.1 No such extensions of time shall be made for any one or more delays unless within ten (10) business days after the beginning of such delays a written request for additional time shall be filed with the Architect / Construction Manager. In case of a continuing cause of delay, only one request is necessary.

8.3.7 The Contractor agrees that the Owner can deduct from the Contract Price, any wages paid by the Owner to any Inspector or Inspectors necessarily employed by the Owner for any number of days in excess of the number of days allowed in Specification section 01800, for completion of the Work.

1.34 PARAGRAPH 9.2 - SCHEDULE OF VALUES

A. Supplement Paragraph 9.2 "Schedule of Values", as follows:

9.2.1 The Schedule of Values shall include bonds and insurance and shall include copies of invoices and / or cancelled checks from bonding and insurance agents for the additional cost of the coverage for the project being billed.

.1 The Prime Contractor must provide draft copies of the Schedule of Values, within fifteen (15) business days from Notice to Proceed. Submit two (2) copies to the Architect.

.1 Schedule of Values shall include separate costs for work at the / each School Project referenced with Architect's Project Number.

.2 Schedule of Values shall also include each type of Work, materials and installation, in accordance with each Specification section, as listed in the Index and / or as shown on Drawings.

.3 The Prime Contractor shall include separate line items for the following:

.1 Bonds,

.2 Insurance,

.3 Mobilization,

.4 General Conditions,

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.5 Submittals,
.6 As-Built Drawings, as per Section 01700,
.7 Punch list items,
.8 CPM Schedule,
.9 Closeout Documents,
.10 Allowances.

1.35 STORED MATERIALS

A. Supplement Paragraph 9.3.2, as follows:

.1 To encourage early purchase, Owner will pay for stored materials and equipment. The following procedures must be followed in order to obtain payment.
  .1 A certificate of insurance naming the Owner as loss beneficiary for the full dollar amount representing the materials stored.
  .2 A consent of Surety in the amount being requisitioned, said Surety being the bonding company of the Prime Contractor.
  .3 Materials to be stored in warehouse must be inspected by the Construction Manager and Contractor will not receive extra compensation for storage costs.
  .4 Any time and traveling expenses for the Construction Manager to visit and inspect equipment stored will be borne by the Contractor making the off-site storage request.
  .5 Payment invoices for materials stored off-site shall be so noted.
  .6 After the receipt of the above, the Construction Manager will endorse same and forward to the Owner for their approval.
  .7 Payment invoices not following the above format will be rejected in total.
  .8 There will be no storage space available in existing buildings. Space in new building may be used for storage only if approved in writing by Construction Manager and all Contractors having work in the area.
  .9 The Contractor will be paid for stored materials no more than the actual or replacement value of the materials. The Contractor will furnish Vendors price lists, priced inventories or other documentation to support claims for payment of materials stored on or off-site.

1.36 PARAGRAPH 9.3 - APPLICATIONS FOR PAYMENT

A. Supplement Paragraph 9.3 “Applications for Payment”, as follows:

9.3.4 Applications for payment which include billing for bonds and insurance shall enclose copies of invoices or cancelled checks from bonding and insurance agents for the additional cost of the coverage for the project being billed.

1.37 PARAGRAPH 9.5 - DECISIONS TO WITHHOLD CERTIFICATION

A. 9.5.1.6 In the first line, delete "and" and substitute "or".

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B. 9.5.1.7 Delete "repeated".

C. Supplement Paragraph 9.5.1, as follows:

.8 Deliberate delay in the submission for approval of names of Subcontractors, materialmen, sources of supply, shop drawings and samples.
.9 Failure to maintain the site in a safe and satisfactory condition in accordance with good construction practices.
.10 Failure of Mechanical Trades or Electrical Trade Subcontractors to comply with mandatory requirements for maintaining record Drawings. The Contractor shall be required to check record Drawings each month. Written confirmation that the record Drawings are up-to-date shall be required by the Architect before approval of the Contractor's monthly payment requisition will be considered.

1.38 PARAGRAPH 9.6 - PROGRESS PAYMENTS

A. Supplement Paragraph 9.6 “Progress Payments”, as follows:

9.6.9 In making progress payments, on Contracts totaling more than $100,000 dollars there shall be retained two percent (2%) of the approved amount when the outstanding balance of the Contract exceeds $500,000, and five percent (5%) of the amount due on each partial payment when the outstanding balance of the Contract is $500,000 or less, until final completion and acceptance of all work covered by the Contract, including the completion of all corrective or punch list items.

9.6.10 In making progress payments, on Contracts totaling less than $100,000 dollars there shall be retained ten percent (10%) of the approved amount until seventy-five percent (75%) of the Contract Price has been paid at which time the retainage for that seventy-five percent (75%) will be reduced to five percent (5%) if in the judgment of the Architect the work is progressing satisfactorily, and on progress payments thereafter there shall be retained ten percent (10%) of the approved amounts until final completion and acceptance of all Work covered by the Contract, including the completion of all corrective or punch list items. The Contractor will be required to provide a Consent of Surety to Reduction in or Partial Release of Retainage (AIA Document G707A), before reduction in retainage will be considered.

9.6.11 Final payment will be made provided the Work has been completed, the Contract fully performed and a final certificate for payment has been reviewed and approved by Architect and Construction Manager.

1.39 PARAGRAPH 9.7 - FAILURE OF PAYMENT

A. In the sixth line, delete “or awarded by binding dispute resolution”.

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1.40 PARAGRAPH 9.8 - SUBSTANTIAL COMPLETION

A. 9.8.1 Modify as follows:

Add at the end of the Subparagraph: "The Work will not be considered substantially complete until all project systems included in the Work are operational as designed and scheduled, all designated or required inspections, certifications, permits, approvals, licenses and other documents from any governmental Authority Having Jurisdiction thereof necessary for the beneficial use and occupancy Project are received, designated instruction of Owner's personnel has been completed, and all final finishes within the Contract are in place. In general, the only remaining Work shall be minor in nature so that the Owner can occupy the building on that date and the completion of the Work by the Contractor would not materially interfere or hamper the Owner's (or those claiming by, through or under the Owner) normal operations. Contractor recognizes that normal operations require the use and occupancy of the Work by students and faculty without interruption and that any punchlist or corrective work shall be done at times when the Work is not so occupied. As a further condition of substantial completion acceptance, the Contractor shall certify that all remaining Work will be completed within thirty (30) consecutive calendar days or otherwise as agreed upon following the date of substantial completion.

B. Supplement Paragraph 9.8.2, as follows:

.1 The Architect's Certificate of Substantial Completion shall be subject to the Owner's final approval.

C. Supplement Paragraph 9.8.3, as follows:

.1 The Contractor shall complete all items attached to the "Certificate of Substantial Completion" within thirty (30) calendar days of issuance of same. If not completed, the Owner may proceed to carry out the Work in accordance with Paragraph 2.4 of the General Conditions. The Owner will suffer financial loss if the project is not substantially complete on the date set forth in the Contract Documents. The Contractor (and the Contractor's Surety) shall be liable for and pay to the Owner the sums hereinafter stipulated and fixed, agreed as liquidated damages for each calendar day of delay until the work is substantially complete.

1.41 PARAGRAPH 9.10 - FINAL COMPLETION AND FINAL PAYMENT

A. 9.10.1 Add the following at the end of the Paragraph:

All warranties and guarantees required pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner as part of the final application for payment. The final Certificate for Payment will not be issued by the Architect until all warranties and guaranties have been received, appropriately transferred to, and accepted by the Owner.

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B. Supplement Paragraph 9.10.1, as follows:

.1 The Architect's Certificate of Final Completion shall be subject to the Owner's final approval.

1.42 GENERAL CONTRACTOR AS OWNER'S SAFETY REPRESENTATIVE

A. Supplement Paragraph 10.1 "Safety Precautions and Programs", as follows:

10.1.1 The General Contractor shall provide all necessary temporary enclosures, guard rails, barricades etc. to adequately protect all workers and public from possible injury.

10.1.2 The General Contractor shall be responsible for the general safeguarding of the Project, for gaining compliance with the safety requirements from all other Contractors and parties engaged in operations at the site, and shall act as the Owner's representative with regard to all safety inspections required and shall perform all necessary functions for this purpose. The Contractor shall designate a "Site Safety Officer".

1.43 PARAGRAPH 10.2 - SAFETY OF PERSONS AND PROPERTY

A. Supplement Paragraph 10.2.8, as follows:

.1 The Contractor shall promptly report in writing to the Owner, Architect and Construction Manager all accidents arising out of or in connection with the Work which caused death, personal injury or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injury or serious property damage is caused, the accident shall be reported immediately by telephone or messenger to the Owner, Architect and Construction Manager.

B. Supplement Paragraph 10.2 "Safety of Persons and Property", as follows:

10.2.12 Contractor is required to follow and enforce the work rules set forth below. Failure to comply with or enforce any of these rules will be grounds for suspension and / or termination of the Contractor:

.1 No use of alcoholic beverages prior to or during working hours. Anyone found impaired will be escorted from the Project site.
.2 No use of illegal drugs or prescription medications which could induce drowsiness or otherwise impair perception or performance. Use of illegal drugs may result in prosecution to the fullest extent of the law. Any warning associated with use of prescription drugs must be complied with, particularly warning against operation of machinery and equipment.
.3 No horseplay or rough-housing will be allowed.
.4 No sexual, racial, ethnic harassment, or similar conduct will be tolerated.
.5 All employees shall use proper sanitation habits, including use of toilet

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facilities and garbage cans.

.6 All employees shall dress in clothing appropriate for the work they are to perform. All personnel are to wear hardhats, safety shoes, glasses, gloves, masks or respirators, noise protection devices, and other protective clothing and equipment as required by OSHA standards.

.7 All equipment is to be properly stored and / or secured at the end of the work day if it is to remain idle for greater than one hour.

.8 All personnel are to be made aware of the availability of Safety Data Sheets (SDS) for materials used at the Project site. This information is available from the Contractor using the product. The Contractor shall maintain a copy of all SDS forms at the construction site office for all personnel to review.

1.44 LOST OR STOLEN ITEMS

A. Supplement Article 10 "Protection of Persons and Property", as follows:

10.5 Lost or Stolen Materials

The Contractor shall protect all materials and equipment for which they are responsible, which is stored at the Project Site for incorporation in the Work, or which has been incorporated into the Work. They shall replace all such materials and equipment which may be lost, stolen or damaged at their expense, whether or not such materials or equipment have been entirely or partially paid for by the Owner.

1.45 INSURANCE

A. Supplement Paragraph 11.1.1, as follows:

.1 Certificate of Insurance shall be submitted within ten (10) business days upon notification of award of Contract.

B. Supplement Paragraph 11.1 “Contractor’s Liability Insurance”, as follows:

11.1.5 Contractor's liability insurance must be maintained until the final Certificate of Payment is issued pursuant to Paragraph 9.10.1 and Completed Operations Insurance is in effect.

11.1.6 Insurance specified to be provided by the Contractor under Paragraph 11.1 shall be on an occurrence basis, as follows:

.1 The Contractor shall take out and maintain during the life of this Contract commercial general liability insurance, covering any and all bodily injury, including accidental death, as well as claims for property damage arising out of or in connection with the Work performed hereunder, whether such Work be performed by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by either of them.

.1 The policy shall name the Owner, the Architect, the Construction Manager and their consultants and agents and employees as additional insureds.

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.2 The Contractor shall take out and maintain comprehensive automobile liability insurance, including coverage for all owned, non-owned and hired vehicles, covering bodily injury and property damage.
  .1 The policy shall name the Owner, the Architect, the Construction Manager and their consultants and agents and employees as additional insureds.
.3 Contractual liability insurance as applicable to the Contractor's obligations under Paragraph 3.18 of the AIA General Conditions and A132 Exhibit A Insurance and Bonds.
.4 Workers' Compensation Insurance of not less than statutory limits.
.5 Completed Operations Insurance written to the limits specified for liability insurance in AIA 132 - 2019, Exhibit A, Article A.3 - Contractor's insurance and Bonds. Coverage shall be required from the date of the start of Beneficial Occupancy until two years after the issuance date of Final Certificate for Payment.
.6 Certificates of insurance must be submitted on the ACORD Form, Certificate of Insurance.
.7 The Contractor shall either:
  .1 require each of their Subcontractors to procure and to maintain during the life of their Subcontracts, Subcontractor's Public Liability and Property Damage, of the type and in the same amounts as specified in the preceding paragraph, or
  .2 insure the activities of their Subcontractors under their respective policies.

1.46 PARAGRAPH 11.4 - LOSS OF USE, BUSINESS INTERRUPTION, AND DELAY IN COMPLETION INSURANCE

A. 11.4 Delete the second sentence in its entirety.

1.47 PARAGRAPH 11.5 - ADJUSTMENT AND SETTLEMENT OF INSURED LOSS

B. Delete Paragraph 11.5.1 and substitute the following:

11.5.1 Owner as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of the Owner's duties. The Owner shall deposit in a separate account, any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made, replacement of damaged work shall be covered by an appropriate change order.

C. Delete Paragraph 11.5.2 and substitute the following:

11.5.2 The Owner, as trustee, shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within five (5) business days after the occurrence of loss to the Owner's exercise of this power.

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1.48 PARAGRAPH 12.1 - UNCOVERING OF WORK

A. 12.1.1 Add "or Contract Sum" at the end of the Paragraph.

1.49 PARAGRAPH 12.2 - CORRECTION OF WORK

A. 12.2.1 Add the following at the end of the Paragraph:

If prior to the date of Substantial Completion, the Contractor, a Subcontractor or anyone for whom either is responsible, uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause each such item to be restored to "like new condition" at no expense to the Owner.

B. 12.2.2.1 Add the following to the end of the Paragraph:

“If payments then or thereafter due to the Contractor are not sufficient to cover such amount, the Contractor, or their Surety, shall pay the difference to the Owner. The appropriate reduction shall be an amount equal to the entire cost of replacing the work performed with work originally specified and intended."

1.50 PARAGRAPH 12.3 - ACCEPTANCE OF NONCONFORMING WORK

A. 12.3.1: Add the following sentence to the end of the Paragraph:

“This Subparagraph relates exclusively to the knowing acceptance of nonconforming work by the Owner. It has no applicability to work accepted by the Owner, Architect or Construction Manager without the knowledge that such work fails to conform to the requirements of the Contract Documents.”

1.51 PARAGRAPH 13.1 - GOVERNING LAW

A. In the first line, delete everything after “located”.

B. Supplement Paragraph 13.1 "Governing Law", as follows:

13.1.1 Contractor must comply with codes, ordinances, rules, regulations, orders and other legal requirements of public authorities, utility companies, National Board of Fire Underwriters, and others which bear on performance of the Work. Deliver to the Owner certificates and other required legal evidence and proof of compliance with the above.

1.52 PARAGRAPH 13.4 - TESTS AND INSPECTIONS

A. 13.4.1 Delete the last two (2) sentences in their entirety.

B. 13.4.2 In lines 5 and 6, add “and Owner” after the word "Architect".

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C. 13.4.3 Add the following at the end of the Paragraph:

The Contractor also agrees that the cost of testing services required for the convenience of the Contractor in their scheduling and performance of the Work and the cost of testing services related to remedial operations performed to correct deficiencies in the Work shall be borne by the Contractor.

1.53 PARAGRAPH 14.1 - TERMINATION BY THE CONTRACTOR

A. Delete Paragraph 14.1.2 in its entirety and substitute the following:

14.1.2 If one of the above reasons exist, the Contractor may, upon fourteen (14) calendar days written notice to the Owner, Construction Manager and Architect, terminate the Contract, unless this reason is cured prior to the expiration of the notice, and recover from the Owner payment of Work properly executed in accordance with the Contract Documents (the basis for such payment shall be as provided in the Contract) and for payment for cost directly related to Work thereafter performed by Contractor in terminating such Work, including reasonable demobilization and cancellation charges provided said Work is authorized in advance by Construction Manager, Architect and Owner.

1.54 PARAGRAPH 14.2 - TERMINATION BY THE OWNER FOR CAUSE

A. Delete Paragraph 14.2 in its entirely and substitute the following:

14.2 TERMINATION OF CONTRACT

14.2.1 Owner May Suspend Work:

.1 Owner may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety (90) calendar days by notice in writing to Contractor, Construction Manager and Architect which shall fix the date on which Work shall be resumed. Contractor shall resume the Work on the date so fixed. Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if they make a claim therefor as provided in Articles 11 and 12.

14.2.2 Owner May Terminate:

.1 Upon the occurrence of any one or more of the following events:

.2 If Contractor is adjudged a bankrupt or insolvent, "subject to the provision of the National Bankruptcy Act and specifically 11 U.S.C., Paragraph 365.

.3 If Contractor makes a general assignment for the benefit of creditors.

.4 If a trustee or receiver is appointed for Contractor or for any of Contractor's property.

.5 If Contractor files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws.

.6 If Contractor repeatedly fails to supply sufficient skilled workers or suitable

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materials or equipment.

.7 If Contractor repeatedly fails to make prompt payments to Subcontractors for labor, materials or equipment.

.8 If Contractor disregards laws, ordinances, rules regulations or orders of any public body having jurisdiction.

.9 If Contractor disregards the authority of the Architect.

.10 If Contractor otherwise violates in any substantial way any provisions of the Contract Documents, Owner may after giving Contractor and their Surety seven days' written notice, terminate the services of Contractor, exclude Contractor from the site and take possession of the Work and of all Contractor's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which Owner has paid Contractor but which are stored elsewhere, and finish the Work as Owner may deem expedient. In such case Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Work, including compensation for additional professional services, such excess shall be paid to Contractor. If such costs exceed such unpaid balance, Contractor shall pay the difference to Owner. Such costs incurred by Owner shall be verified by Architect and incorporated in a Change Order, but in finishing the Work, Owner shall not be required to obtain the lowest figure for the Work performed.

.11 Where Contractor's services have been so terminated by Owner, the termination shall not affect any rights of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

.12 Upon seven days' written notice to Contractor and Architect, Owner may without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, Contractor shall be paid for all Work executed and any expense sustained plus reasonable termination expenses.

1.55 PARAGRAPH 15.1 - CLAIMS

A. Supplement Paragraph 15.1.5 as follows:

After the first sentence, add: "Said notice shall itemize all claims and shall contain sufficient detail and substantiating data to permit evaluation of same by Owner, Architect and Construction Manager. No such claim shall be valid unless so made."

At the end of the Subparagraph, add: "Any change in the Contract Sum resulting from such claim shall be authorized only by Change Order or Construction Change Directive, as the case may be."

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1.56 RESOLUTION OF CLAIMS AND DISPUTES

A. Delete the last sentence in Paragraph 15.2.5.

B. Delete Paragraph 15.2.6 in its entirety.

C. Delete Paragraph 15.2.6.1 in its entirety.

1.57 PARAGRAPH 15.3 - MEDIATION

A. Delete Paragraph 15.3 “Mediation”, in its entirety.

1.58 PARAGRAPH 15.4 - ARBITRATION

A. Delete Paragraph 15.4 "Arbitration” in its entirety and substitute the following:

15.4 - LITIGATION

15.4.1 The Owner and Contractor agree that all claims, disputes and other matters in question between the parties arising out of or relating to the Project or this Contract or breaches thereof, shall be heard in a Court of competent jurisdiction venued in the project's County, New Jersey, except as otherwise specified in N.J.S.A. 2A:30A-2.

END OF SECTION 00800

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SECTION 00850 - CONTRACT DRAWINGS

1.1 All Drawings listed on Drawing No. G001, "Title Sheet and Drawing Index," dated February 6, 2026, unless otherwise revised or amended (via Addenda, Bulletin, etc.), shall form a part of the Bid Documents.

END OF SECTION 00850

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SECTION 00860 - LAWS GOVERNING PUBLIC WORK

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The paragraphs below supplement the AIA A232 - General Conditions. Attention is called, but not limited, to the following Laws Governing Public Work.

1.2 STATE SALES AND USE TAX EXEMPTION

A. Supplement paragraph 3.6 "Taxes" as follows:

3.6.1 As a New Jersey governmental entity, the Board of Education is exempt from the requirements under New Jersey state sales and use tax (N.J.S.A. 54:32B-1 et seq.), and does not pay any sales or use taxes. Bidders should note that they are expected to comply with the provisions of said statute and the rules and regulations promulgated thereto to qualify them for examinations and reference to any and all labor, services, materials and supplies furnished to the Board of Education. Contractors may not use the Board's tax identification number to purchase supplies, materials, service or equipment, for this project.

.1 A Contractor may qualify for a New Jersey Sales Tax Exemption on the purchase of materials, supplies and services when these purchases are used exclusively to fulfill the terms and conditions of the Contract with the Board of Education. All Contractors are referred to New Jersey Division of Taxation-Tax Bulletin S&U-3 and in particular, Contractor's Exempt Purchase Certificate (Form ST-13). Again, Contractors are not permitted to use the Board's tax identification number to purchase supplies, materials, services of equipment.

1.3 MUNICIPAL REQUIREMENTS

A. Supplement paragraph 3.7 "Permits, Fees, Notices and Compliance with Laws" as follows:

3.7.1.1 N.J.S.A. 52:27D-130, provides that local Municipal Construction Enforcing Agency issue required construction permit, perform required inspections during construction, and issue required certificate of occupancy upon completion of Project.

3.7.1.2 N.J.S.A. 52:27D-126C, "No county, municipality, or any agency or instrumentality thereof shall be required to pay any municipal fee or charge in order to secure a construction permit for the erection or alteration of any public building or part thereof from the municipality wherein the building may be located. No erection or alteration of any public building or part thereof by a county, municipality, school board, or any agency or instrumentality thereof shall be subject to any fee, including any surcharge or training fee, imposed by any department or agency of State government pursuant to any law, or rule or regulation, except that nothing contained in this section shall be interpreted as preventing the imposition of a fee

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upon a board of education by either the Department of Education for plan review or by a municipality for the review of plans submitted to it pursuant to the provisions of section 12 of P.L.1975, c.217 (C.52:27D-130).

3.7.1.3 N.J.S.A. 40:55D-8(d), A municipality shall exempt a Board of Education from the payment of any fee related to the Municipal Land Use Law.

3.7.1.4 N.J.S.A. § 52:27d-126e (amended effective July 21, 2017) Waiver of construction permit surcharge or enforcing agency fee for construction, alteration, etc. to promote accessibility by persons with disabilities to existing public or private structures or facilities, or to promote accessibility by veterans with disabilities to their living units.

1.”a. Notwithstanding the provisions of the "State Uniform Construction Code Act," P.L. 1975, c.217 (C.52:27D-1 19 et seq.), or any rules, regulations or standards adopted pursuant thereto, to the contrary, the governing body of any municipality which has appointed an enforcing agency pursuant to the provisions of section 8 of P.L.1975, c.217 (C.52:27D-126) may, by ordinance, provide that no person shall be charged a construction permit surcharge fee or enforcing agency fee for any construction, reconstruction, alteration or improvement designed and undertaken solely to promote accessibility by disabled persons to an existing public or private structure or any of the facilities contained therein.

The ordinance may further provide that a disabled person, or a parent or sibling of a disabled person, shall not be required to pay any municipal fee or charge in order to secure a construction permit for any construction, reconstruction, alteration or improvement which promotes accessibility to their own living unit.

For the purposes of this subsection, "disabled person" means a person who has the total and permanent inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment, including blindness, and shall include, but not be limited to, any resident of this State who is disabled pursuant to the federal Social Security Act (42 U.S.C.416), or the federal Railroad Retirement Act of 1974 (45 U.S.C.231 et seq.), or is rated as having a 60% disability or higher pursuant to any federal law administered by the United States Veterans' Act. For purposes of this paragraph "blindness" means central visual acuity of 20/200 or less in the better eye with the use of a correcting lens. An eye which is accompanied by a limitation in the fields of vision such that the widest diameter of the visual field subtends an angle no greater than 20 degrees shall be considered as having a central visual acuity of 20/200 or less.

b. (1) Notwithstanding the provisions of the "State Uniform Construction Code Act," P.L. 1975, c.217 (C.52:27D-119 et seq.) or any rules, regulations or standards adopted pursuant thereto to the contrary, the governing body of any municipality which has appointed an enforcing agency pursuant to the

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provisions of section 8 of P.L. 1975, c.217 (C.52:27D-126) shall not charge a person who has a service-connected disability declared by the United States Department of Veterans Affairs, or its successor, to be a total or 100% permanent disability that would entitle them to a property tax exemption under section 1 of P.L.1948, c.259 (C.54:4-3.30) or a spouse, parent sibling, or guardian of the disabled veteran, a construction permit surcharge fee or enforcing agency fee for any construction, reconstruction, alteration, or improvement designed and undertaken solely to promote accessibility by the disabled veteran to their own living unit.

(2) A municipality that has granted an exemption from a construction permit surcharge fee or enforcing agency fee pursuant to paragraph (1) of this subsection may apply to the Department of Community Affairs, in accordance with rules and regulations promulgated by the Commissioner of Community Affairs for this purpose, for reimbursement of those exempt fees.

B. Utility Connection Fees: The Contractor shall pay utility connection fees and shall be reimbursed by Owner within thirty (30) days of presentation and Owner approval of receipt for same.

C. Certificates of Occupancy: Contractors shall be responsible for obtaining all Certificates of Occupancy.

1.4 TIME INCLUDING COMPLETION

A. Supplement Article 8 "Time" as follows:

8.1.5 The term "completed" in N.J.S.A. 18A:18A-19 shall mean substantial completion as defined in this Article 8.

8.1.6 The term "Working Days" as used to compute the time of completion shall mean Mondays through Fridays, exclusive of the thirteen major yearly holidays, as listed on the official State of New Jersey website, https://www.state.nj.us/nj/about/facts/holidays/

B. Supplement Article 8.3 "Delays and Extension of Time" as follows:

8.3.5 The Contractor agrees that the Owner can deduct from the Contract Price, any wages paid by the Owner to any Inspector or Inspectors necessarily employed by the Owner for any number of days in excess of the number of days allowed in the Specifications for completion of the work.

1.5 NONDISCRIMINATION AND MISCELLANEOUS LABOR PROVISIONS

A. Attention is called to the following which supplement paragraph 13.1 "Antidiscrimination Provisions" as follows:

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13.1.2 N.J.S.A. 10:2-1, Antidiscrimination provisions. Every Contract for or on behalf of the State or any county or municipality or other political subdivision of the State, or any agency of or authority created by any of the foregoing, for the construction, alteration or repair of any public building or public work or for the acquisition of materials, equipment, supplies or services shall contain provisions by which the Contractor agrees 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 such 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 their 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 contracting public agency, 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. This Contract may be canceled or terminated by the contracting public agency, 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 contracting public agency of any prior violation of this section of the Contract.

No provision in this section shall be construed to prevent a board of education from designating that a Contract, Subcontract or other means of procurement of goods, services, equipment or construction shall be awarded to a small business enterprise, minority business enterprise or a women's business enterprise pursuant to N.J.S.A. 18A:18A-51 et seq.

During the performance of this Contract, the Contractor agrees to Mandatory Equal Employment Opportunity Language, as shown in Exhibit B, included with the Bid forms.

13.1.3 N.J.S.A. 34:11-56.25 et seq., in accordance with which the Contractor(s) and Subcontractor(s) are required to do the following:

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.1 Pay to all workers engaged in the performance of services directly upon the work not less than the prevailing rate of wages. In the event that it is found that any worker employed by the Contractor(s) or any Subcontractor(s) has been paid a rate of wage less than the prevailing wage required to be paid by such Contract, the Owner may terminate the Contractor'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.

.1 Prime Contractor(s) shall post the New Jersey Department of Labor and Workforce Development - Prevailing Wage Rate Determination in accordance with N.J.S.A. 34:11-56.25 et seq., which establish and enforce a prevailing wage level for workers engaged in the project, based on the effective date where the Contract is to be awarded. This document is to be posted in a prominent and easily accessible place at the site of the work and at such a place or places as are used to pay workers their wages. The prevailing wage rates shall be incorporated into the bid Specification manual as a reference and part of the Contract. A copy of the project's prevailing wage rates, as applicable to this Project, are on file at the Architect's office.

.2 Before final payment, furnish Owner with an Affidavit stating that all workers have been paid in accordance with the New Jersey Prevailing Wage Act.

.3 Keep an accurate record showing the name, craft or trade and actual hourly rate of wages paid to each workman employed by them in connection with their work. Preserve records for 2 years from date of payment.

.4 Upon request, the Contractor(s) and each Subcontractor shall file written statements certifying to the amounts then due and owing to any and all workers for wages due on account of the Work. The statement shall set forth the names of the persons whose wages are unpaid and the amount due to each. These statements shall be verified by the oaths of the Contractor(s) or Subcontractor(s), as the case may be.

1.6 AMERICANS WITH DISABILITIES ACT; FACILITIES FOR PERSONS WITH DISABILITIES

A. The Contractor must comply with all provisions of Title II of the Americans with Disabilities Act (ADA), in accordance with 42 U.S.C. S121.01 et seq. The Owner further recognizes that all Specifications for the construction, remodeling or renovation of any public building shall provide facilities for persons with disabilities. Reference: N.J.S.A. 18A:18A-17.

B. It is further recommended that Bidders are required to read the Americans with Disabilities Act (Act) language form that is included in the bid forms. The form shall be signed to show agreement with the provisions of Title II of the Act and the provisions are to be made a part of the Contract. The signed form shall be submitted

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with the bid proposal. The Contractor is obligated to comply with the Act and to hold the Owner harmless.

1.7 AMERICAN GOODS AND PRODUCTS

A. Supplement Paragraph 13.1 "Governing Law" as follows:

13.1.5 N.J.S.A. 18A:18A-20 et seq., American goods and products to be used where possible. "Each Board of Education shall provide as a condition of the Contract that only manufactured and farm products of the United States, where ever available, be used in the work."

1.8 PAYMENTS TO LISTED SUBCONTRACTORS UNDER SINGLE OVERALL CONTRACT

A. Supplement Paragraph 13.1 "Governing Law" as follows:

13.1.6 Pursuant to N.J.S.A. 18A:18A-18(c), "in every case in which a [Single Overall Contract is awarded], all payments required to be made under such Contract for Work, goods and services supplied by a Subcontractor may, upon certification of the Contractor of the amount due to the Subcontractor, be paid directly to the Subcontractor."

1.9 ANNUAL DISCLOSURE OF CONTRIBUTIONS TO NEW JERSEY ELECTION LAW ENFORCEMENT COMMISSION (ELEC)

A. N.J.S.A. 19:44A-20.27 establishes a new disclosure requirement for business entities. It requires that, when a business entity has received in any calendar year $50,000 or more in public Contracts with public entities, it must file an annual report with the Election Law Enforcement Commission (ELEC). The report shall disclose any contribution of money or any other thing of value, including an in-kind contribution, or pledge to make a contribution of any kind:

1. To a candidate for or the holder of any public office having ultimate responsibility for the awarding of public Contracts, or,

2. To a political party committee, legislative leadership committee, political committee or continuing political committee.

B. The report will include all reportable contributions made by the business entity during the 12 months prior to the reporting deadline. ELEC will be promulgating a form and procedures for filing commencing in January 2007. ELEC can also impose fines for failure to comply with this requirement.

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1.10 PROMPT PAYMENT ACT

A. The Owner will issue timely payments, within 30 days after billing date, to Contractors in accordance with the requirements of the Prompt Payment Act, N.J.S.A. 2A:30A-1, et seq. The Bidders are hereby notified that the Owner as a public entity requires all payments to be approved at scheduled public board meetings. The vote on authorization for payments will be made at the first public meeting of the Board following the Board's receipt of the Architect's authorization for payment and paid during the subsequent payment cycle.

1.11 NEW JERSEY DEPARTMENT OF TREASURY

A. N.J.S.A 18A:18A-49.5 Board of Education, Compliance; Report of False Certification.

1. 3.b. If the board determines that a person or entity has submitted a false certification concerning its engagement in prohibited activities in Russia or Belarus pursuant to section 1 of P.L.2022, c.3 (C. 52:32-60.1), the board shall report to the New Jersey Attorney General the name of that person, and the Attorney General shall determine whether to bring a civil action against the person to collect the penalty prescribed in subsection c. of section 1 of P.L.2022, c.3 (C. 52:32-60.1).

B. In accordance with N.J.S.A. 52:32-57 (P.L. 2012, c.25), as amended and supplemented, the following Comprehensive Iran Sanctions, Accountability, and Divestment Act of 2010 will be a condition of the Contract as follows:

1. 3.a. A person or entity that, at the time of bid or proposal for a new Contract or renewal of an existing Contract, is identified on a list created pursuant to subsection b. of this section as a person or entity engaging in investment activities in Iran as described in subsection f. of section 2 of this act, shall be ineligible to, and shall not, bid on, submit a proposal for, or enter into or renew, a Contract with a State agency for goods or services.

C. In accordance with P.L.2012, Chapter 25, C.52:32-58, as amended and supplemented, the following Comprehensive Iran Sanctions, Accountability, and Divestment Act of 2010 will be a condition of the Contract as follows:

1. 4.a. A State agency shall require a person or entity that submits a bid or proposal or otherwise proposes to enter into or renew a Contract to certify, at the time the bid is submitted or the Contract renewed, that the person or entity is not identified on a list created pursuant to subsection b. of section 3 of this act as a person or entity engaging in investment activities in Iran described in subsection f. of this act.

1.12 EQUAL EMPLOYMENT OPPORTUNITIES AND AFFIRMATIVE ACTION

A. 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.

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1. The construction Contractors shall complete and submit an Initial Project Workforce Report Form AA-201 after notification of award. Proper completion and submission of this Report shall constitute evidence of the Contractor's compliance with the regulations. Failure to submit this form may result in the Contract being terminated. The Contractor 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 Public Agency Compliance Officer. The EEO/AA evidence must be submitted after notification of award, but prior to signing a construction Contract. All Public Agencies must retain the affirmative action evidence in their files for review by the Division.

B. Initial Project Workforce Report - Construction (AA201)

1. In accordance with the requirements of the New Jersey Department of Labor & Workforce Development Construction EEO Compliance Monitoring Unit, the Initial Project Workforce Report-Construction (AA201) document, must be submitted to the Public Agency that awards the Contract and the Department of Labor & Workforce Development Construction EEO Compliance Monitoring Program after notification of award, but prior to signing the Contract. For more information, visit:

https://www.nj.gov/treasury/contract_compliance/documents/pdf/guidelines/pa.pdf

1.13 OFFICE OF THE STATE COMPTROLLER

A. N.J.A.C. 19:70-1.6: Authority to Audit or Review Contract Records

1. Relevant records of private vendors or other persons entering into Contracts with covered entities are subject to audit or review by the Office of the State Comptroller (OSC) pursuant to N.J.S.A. 52:15C-14(d).
   a. The (Prime 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. N.J.A.C. 19:70-1.6.

B. Contractor/Vendor Requirements-Office of the New Jersey State Comptroller

1. Contractors/Vendors doing business with the Owner is reminded of the following legal requirements pertaining to the Office of the New Jersey State Comptroller:
   a. Access to Relevant Documents and Information - N.J.S.A. 52:15C-14 (d)
      1) Private Vendors or other persons contracting with or receiving funds from a unit in the Executive branch of State government, including an entity exercising executive branch authority, independent State

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authority, public institution of higher education, or unit of local government or Board of Education shall upon request by the State Comptroller provide the State Comptroller with prompt access to all relevant documents and information as a condition of the Contract and receipt of public monies. The State Comptroller shall not disclose any document or information to which access is provided that is confidential or proprietary. If the State Comptroller finds that any person receiving funds from a unit in the Executive branch of State government, including an entity exercising executive branch authority, independent State authority, public institution of higher education, or unit of local government or Board of Education refuses to provide information upon the request of the State Comptroller, or otherwise impedes or fails to cooperate with any audit or performance review, the State Comptroller may recommend to the contracting unit that the person be subject to termination of their Contract, or temporarily or permanently debarred from contracting with the Owner.

1.14 ANTI-BULLYING BILL OF RIGHTS ACT (P.L. 2010.C.122)

A. N.J.S.A. 18A:37-16 provides:

1. A member of a Board of Education, school employee, student or volunteer shall not engage in reprisal, retaliation or false accusation against a victim, witness or one with reliable information about an act of harassment, intimidation or bullying.

2. A member of a Board of Education, school employee, contracted service provider, student or volunteer who has witnessed, or has reliable information that a student has been subject to, harassment, intimidation or bullying shall report the incident to the appropriate school official designated by the school district's policy, or to any school administrator or safe schools resource officer, who shall immediately initiate the school district's procedures concerning school bullying.

3. A member of a board of education or a school employee who promptly reports an incident of harassment, intimidation or bullying, to the appropriate school official designated by the school district's policy, or to any school administrator or safe schools resource officer, and who makes this report in compliance with the procedures in the district's policy, is immune from a cause of action for damages arising from any failure to remedy the reported incident.

4. A school administrator who receives a report of harassment, intimidation, or bullying from a district employee, and fails to initiate or conduct an investigation, or who should have known of an incident of harassment, intimidation, or bullying and fails to take sufficient action to minimize or

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eliminate the harassment, intimidation, or bullying, may be subject to disciplinary action.

1.15 CONTROLLING SILICA EXPOSURES IN CONSTRUCTION

A. Occupational Safety and Health Administration (OSHA) - U.S. Department of Labor: OSHA 29 CFR 1926.1153, 2017.

1. The above referenced guidance advisory document is not a standard or regulation, and it creates no new legal obligations. The document is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace. The Occupational Safety and Health Act requires employers to comply with safety and health standards promulgated by OSHA or by a state with an OSHA approved state plan. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the Act, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement any specific recommendations contained within this document is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.
   a. This guidance document addresses the control of employee exposures to respirable dust containing crystalline silica, which is known to cause silicosis, a serious lung disease, as well as increase the risk of lung cancer and other systemic diseases.
   b. This document provides information on the effectiveness of various engineering control approaches for several kinds of construction operations and equipment, and contains recommendations for work practices and respiratory protection, as appropriate.
   c. OSHA encourages employers to conduct periodic exposure monitoring to confirm that engineering and work practice controls are effective and that appropriate respiratory protection is being used where necessary.

2. The above referenced advisory document can be found at:

   https://www.osha.gov/dsg/topics/silicacrystalline/construction_info_silica.html

1.16 CERTIFICATION OF NON-DEBARMENT FOR FEDERAL GOVERNMENT CONTRACTS

1. Pursuant to N.J.S.A. 52:32-44.1, 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

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prohibited person or entity.

a. Prior to awarding a Contract for public work, a local units must obtain written certification from the contracting person or entity through the form (Certification of Non-Debarment for Federal Government Contracts, N.J.S.A. 52:32-44.1, attesting to their non-debarment from contracting with federal government agencies.
b. The contracting firm agrees, by submitting this certification, that it is not included on any federal debarment list or the Workplace Accountability in Labor List (WALL) maintained by NJDOL under N.J.S.A. 34:1A-1.16, the law establishing the WALL.

1.17 CONTRACTOR EMPLOYEES PROCEDURE FOR CRIMINAL HISTORY RECORD CHECKS

1. The Office of Student Protection (OSP) suggests the following recommendation when educational facilities submit Contractor employees (i.e., masons, building and roofing companies) for short-term and long-term projects. The school official, acting as a liaison to the construction Contractor, must share with other school district administrators the names of the company's employees who will be submitting to a criminal record check. This process will assure that employees of the Contractor who have not obtained their approval for employment and are disqualified or ineligible for school employment will be identified as a Contractor service provider employee and not continue to be employed at school facilities and have direct contact with the student population.

2. To ensure compliance with the requirements of N.J.S.A. 18A:6-7.1 et seq., the Chief School Administrator shall direct the school official acting as a liaison to the construction company to obtain a list of individuals who will be employed by the Contractor for the school facility project that will be undergoing a criminal history record check. The liaison shall then provide a copy of this list to the Superintendent's Office and Human Resource Director, as these offices will receive any adverse action correspondence from the OSP related to the criminal history record check process.

3. Upon receipt of disqualification or ineligibility correspondence, the Superintendent's Office or Human Resource personnel shall review the contracted company list in order to determine if the subject of that letter is either a school employee or an employee of any Contract service provider and take the appropriate action.

4. As with any school employee, **no person** shall be employed at a school facility without having first obtained an approval for employment from the Office of Student Protection.

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5. Approvals for employment for these type contracted employees shall be maintained with the liaison and copies forwarded to the Superintendent's Office.

1.18 LABOR-REGISTERED APPRENTICESHIP PROGRAM

1. As of May 1, 2019, N.J.S.A. 34:11-56.50, et seq. requires Contractors that directly employ craftworkers to participate in a United States Department of Labor-registered apprenticeship program as a condition of initial or renewed PWCR registration. Contracting units are not responsible for verifying Contractor participation in a registered apprenticeship program.

2. A Contractor working on a Public Works Project who directly employs craft workers, must certify to the NJDOL that they participate in a registered Apprenticeship Program for each craft they employ as defined in N.J.S.A. 34:11-56 and CFR , et al.

3. "Registered apprenticeship program" means an apprenticeship program which is registered with and approved by the USDOL, which provides each trainee with combined classroom and on-the-job training in an occupation recognized as an apprenticeable occupation, and which meets the program standards of enrollment and graduation under 29 C.F.R. §29.6. N.J.S.A. 34:11-56.50.

1.19 NEW JERSEY PREVAILING WAGE ACT

1. An Act concerning certain Contracts for public work and amending and supplementing N.J.S.A. 34:11-56.27.

   a. N.J.S.A. 34:11-56.27a. Payment of prevailing wage rates; certification required of certain Bidders; rules and regulations.

      1) a. If a person makes the lowest bid for a Contract with a public body for public work subject to the provisions of the "New Jersey Prevailing Wage Act," P.L.1963, c.150 (C.34:11-56.25 et seq.) and that bid is ten percent or more lower than the next lowest bid for the Contract, the person making the lowest bid shall certify to the public body that the prevailing wage rates required by that act shall be paid. If the Bidder does not provide the certification prior to award of the Contract, the public body shall award the Contract to the next lowest responsible and responsive Bidder. This certification shall be required only when a public body is engaging in competitive bidding for public work.

      b. The Commissioner of Labor and Workforce Development, in consultation with the Division of Local Government Services in the Department of Community Affairs, shall promulgate rules and regulations concerning the standardization of the certification necessary to effectuate the provisions of this section.

      2) N.J.S.A. 34:11-56.27. Required Contract provisions; liability of

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Contractor and Sureties for excess costs; rules and regulations.

a. Every Contract in excess of the prevailing wage Contract threshold amount for any public work to which any public body is a party or for public work to be done on property or premises owned by a public body or leased or to be leased by a public body shall contain a provision stating the prevailing wage rate which can be paid (as shall be designated by the commissioner) to the workers employed in the performance of the Contract and the Contract shall contain a stipulation that such workers shall be paid not less than such prevailing wage rate. Such Contract shall also contain a provision that in the event it is found that any worker, employed by the Contractor or any Subcontractor covered by said Contract, has been paid a rate of wages less than the prevailing wage required to be paid by such Contract, the public body, the lessee to whom the public body is leasing a property or premises or the lessor from whom the public body is leasing or will be leasing a property or premises may terminate the Contractor'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 Contractor and their Sureties shall be liable for any excess costs occasioned thereby to the public body, any lessee to whom the public body is leasing a property or premises or any lessor from whom the public body is leasing or will be leasing a property or premises.

b. Compliance with New Jersey Prevailing Wage Act (N.J.S.A. 34:11-56.25 et seq.)

1) Every Contractor and Subcontractor performing services in connection with this Project, shall pay all workers a wage rate not less than the published prevailing wage rates, for the locality the work is being performed, as designated by the New Jersey Department of Labor and Workforce Development (NJ DLWD).

2) Wage rates for the county of the location of the Public Agency (Owner), as published by the State Department of Labor and Workforce Development (DLWD), can be viewed at https://www.nj.gov/labor/wagehour/wagerate/prevailing_wage_determinations.html.

3) The Contractor must complete and sign the "Prevailing Wage Certification" form included in the bid package and submit with their bid. This form confirms the Contractor's intention to comply with the Act. The Owner may terminate the Contract if Contractor fails to pay workers prevailing wage.

4) The prevailing wage rates in effect at the time of award, will be included by Owner as a part of the construction Contract.

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SECTION 00870 - MISCELLANEOUS REQUIREMENTS

PART 1 - GENERAL

1.1 JOB SITE MEETINGS

A. Regularly scheduled job meetings shall be held at a location and time convenient to the Owner's Representatives, Construction Manager, Architect and the Contractor. The Prime Contractor shall attend such meetings, or be represented by a person in authority who can speak for and/or make decisions for the Contractor.

B. Attendance by the Contractor is mandatory, whether the meetings are weekly, bi-weekly or at whatever interval is determined by the Architect.

1. Unless given prior approval by the Architect, the Prime Contractor will be fined $250.00 for each regularly scheduled meeting for which they are not represented by a person the Contractor has advised the Architect and Construction Manager has authority and who can speak for and/or make decisions for the Contractor. Fine amounts shall be withheld and deducted from the Contract Sum.

1.2 STRUCTURAL SAFETY STANDARDS AND CODES

A. The standards, codes and design data referred to in the New Jersey "State Uniform Construction Code", apply to the work of the Contract, where applicable.

B. Contractor shall comply with all applicable requirements of the Uniform Fire Safety Act N.J.S.A. 52:27D-192 et seq.

1.3 OWNER'S RIGHT TO OCCUPY

A. The Owner reserves the right to occupy any portion of the Project which is ready for occupancy prior to completion and acceptance of the Project, after Local Municipal Construction Enforcing Agency approval.

B. The occupancy of any portion of the Project does not constitute an acceptance of any work nor does it waive the Owner's right to liquidated damages or constitute an acceptance of any Work as the Project will be accepted as a whole and not in units. Prior to such occupancy, however, the Architect, Construction Manager, a representative of the Owner, and the Contractor shall fully inspect the portions of the Project to be occupied, preparing a complete list of omissions of materials, faulty workmanship, or any items to be repaired, torn out or replaced. The Owner will assume responsibility for damage to premises so occupied of any items not on this list when such damage is due to greater than normal wear and tear, but does not assume responsibility for improper or defective workmanship or materials.

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1.4 OWNER'S GENERAL REQUIREMENTS

A. The Owner requires that the Contractor demonstrate a safety and health program/plan, which includes, but is not limited to first aid, fire protection, housekeeping, illumination, sanitation, personal protective equipment, medical, exit, emergency action plans and all other issues required by governmental Agencies Having Jurisdiction over the work of this project.

B. The following Owner's General Requirements shall be enforced during construction and until final completion of the work:

1. No deliveries of construction materials or equipment is to take place during the arrival and departure of students from the/their respective school(s). Verify and coordinate arrival and departure time with the Principal(s).

2. All construction materials and equipment shall be stored behind the construction fence.

3. No smoking on any of the School's Property.

4. All workers must wear shirts at all time.

5. Use of profanity will not be tolerated.

6. The Prime Contractor shall provide identification cards for their Subcontractors, employees, etc.

7. The Contractor shall comply with the requirements of all local ordinances including for noise.

8. The Contractor and their Subcontractors shall not interact with students or staff, other than those identified by the Owner as a representative of the Owner.

1.5 ENVIRONMENTAL PROTECTION

A. Conform to New Jersey Department of Environmental Protection Regulations N.J.A.C. 7:27, sub-chapters 5 and 7 and all other applicable standards.

B. Conform to New Jersey Statute N.J.S.A. 26:2C-9.2 which requires that no person shall construct, install, alter or operate any equipment capable of causing the emission of air contaminants into the open air or control apparatus which prevents or controls the emission of air contaminants until an application has been filed with and approved by the Department of Environmental Protection.

1.6 RELATIONSHIP OF ARCHITECT AND CONSTRUCTION MANAGER

A. Where reference is made to "Architect" in these Specifications it will in some cases

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be interpreted as meaning "Construction Manager". Spheres of influence are defined in general as follows:

Architect:
Interpretation of Bid Documents.
Decisions relative to artistic effect.
Review and approval of shop drawings, product data, samples.
Review, recommendation and preparation of change orders.
Receipt of record drawings, operating and maintenance manuals.
Assistance with start-up, adjusting, operating and maintenance.
Review and recommendation of bid breakdown.
Review and approval of applications for progress payments.
Preparation of Punch Lists.
Close-out of Contract and determination of final completion.

Exclusions: Construction means, methods, techniques, sequences or procedures, safety precautions, acts or omissions of Contractors, Subcontractors, or any other persons.

Construction Manager:
Project meetings.
Monitoring of Contractors' work.
Review and approval of bid breakdown (Schedule of Values).
Review and forwarding of applications for progress payments.
Review and recommendations regarding proposed changes.
Administration of Progress Schedule and construction time schedules.
Assist in Preparation of Punch Lists.
Assist in Close-out of contracts and determination of final completion.

Exclusions: Construction means, methods, techniques, sequences or procedures, safety precautions, acts or omissions of Contractors, Subcontractors, or any other persons.

1.7 SEPARATE TRADES COORDINATION

A. The Contractor for General Construction shall install the access doors, sleeves and inserts furnished to them, in the manner, and in the locations designated by the Contractor furnishing sleeves and inserts.

B. The Contractor for General Construction shall provide chases, recesses, and unsleeved openings in new construction work as required to accommodate the work of other Contractors, provided Contractors requiring the chases, recesses, and other openings furnish the necessary information regarding size and location in the construction promptly, and in accordance with the established construction schedule, so that the chases, recesses, and other openings can be built-in by the Contractor for General Construction as the General Construction Work progresses.

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C. The Contractor for General Construction shall set anchor bolts and other accessories furnished to them, in the manner, and in the locations directed by the Contractor furnishing the anchor bolts and other accessories.

D. The Contractor for General Construction shall provide foundations and supports for equipment furnished under the General Construction Contract, and foundations and supports shown on the General Construction Contract, Drawings for equipment furnished by other Contractors. All other foundations and supports shall be provided by the Contractor requiring the foundations and supports to accommodate the work.

1.8 CERTIFIED PAYROLLS

A. Pursuant to N.J.A.C. 12:60-5.1(c)(1)(i), the Contractor shall furnish to the Owner certified payroll records each payroll period within ten (10) days of the payment of wages, indicating name, craft, social security number and actual hourly rate of wages paid to each worker employed on the project. A certified payroll record is defined as "a payroll record which is attested to by the employer, or a corporate officer of such company, or an authorized agent of the employer."

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SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The work of this Section applies to all Bid Documents including Drawings, Division 1 - Miscellaneous Requirements Sections and Specifications Sections included in Part-2 through Part-6.

1.2 SUMMARY

A. Section Includes:

1. Project description.
2. Contract scope description.
3. Contractor's use of the premises.
4. Preconstruction meeting.
5. Security procedures.

1.3 PROJECT DESCRIPTION

A. The project consists of the Renovations to Princeton High School for the Princeton Public Schools, Board of Education, Mercer County, New Jersey.

B. Contract Documents prepared by Fraytak Veisz Hopkins Duthie, P.C. Architects / Planners, (Project Number: FVHD-5516A2) and their Consulting Mechanical/Electrical Engineer: French & Parrello Associates, P.A., Wall, NJ.

1.4 CONTRACT SCOPE DESCRIPTION

A. The work consists of but is not limited to the following:

1. Renovate existing spaces to create the following rooms:
   a. Flex Classroom #037A & 037B, which are separated with an operable partition,
   b. Classroom #035,
   c. Office #036,
   d. Gallery A & Gallery B, which are separated with an operable partition,
   e. Storage Room #033,
   f. Conference Room #034,
   g. Single Occupant Toilet Rooms #030 & 031,
   h. Storage / Mechanical Room #033,
   i. Corridor #C001 & C002.

2. All plumbing, mechanical and electrical system work as indicated on the drawings and specifications.

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3. All indicated casework and equipment.

4. All other indicated work.

B. Alternate Bid:

1. Alternate Bid No. 1: Epoxy Floor System

C. Single Overall Contract includes:

1. All work in accordance with Drawings, Parts 2, 4, 5 and 6 Specification Sections and in accordance with Bid Documents.

2. General Construction Work includes:
   a. Work that is primarily architectural in nature plus work traditionally recognized as general construction in accordance with Drawings and as listed as a part of Part 2 Specification sections, unless otherwise indicated below:
      1) Also includes both administrative and coordination responsibilities.
         a) General Construction Contractor is responsible for all coordination between their work and work of all other Prime Subcontractors.
      2) Provide and install the miscellaneous Structural Steel.
      3) Provide and install the metal fabrications.
      4) Furnishing stainless steel sinks, fixtures, accessories, and all items supplied by the casework and equipment Subcontractor in accordance with Drawings and Specification sections in Division 11, for installation by the Plumbing Work Subcontractor.

3. Plumbing, Drainage System Work includes:
   a. Piping servicing domestic water piping and drainage system work and connection of equipment tied into the above types of systems and including all work in accordance with Drawings and Part-4 Specification sections.
      1) Work shall include demolition and removals, as indicated or required, to allow for new construction.
      2) Work shall include reinstallation, cutting, patching, finishing and repair work associated with Plumbing and Drainage system work, as indicated or required.
   b. Subsequent excavation, backfill and compaction of trenches after the work of the General Construction Work, as required by the installation of plumbing utilities inside the building. Work shall be performed in accordance with requirements of Part-2 Specification sections.

4. Heating, Ventilating, Air Conditioning and Refrigeration Work includes:
   a. Heating, ventilating, and air conditioning systems as well as the temperature control systems and including all work in accordance with Drawings and Part-5 Specification sections.
      1) Work shall include demolition and removals, as indicated or required, to allow for new construction.

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2) Work shall include reinstallation, cutting, patching, finishing and repair work associated with HVACR work, as indicated or required.

5. Electrical Work includes:
   a. The work necessary for electrical power distribution, lighting, and the connections to equipment tied into such systems, including all work in accordance with Drawings and Part-6 Specification sections.
      1) **Work shall include power distribution and wiring for all indicated electrically operated equipment and fixtures, (in Parts 2, 4, 5 and 6), whether shown or not on Drawings.**
      2) Work shall include demolition and removals, as indicated or required, to allow for new construction.
      3) Work shall include reinstallation, cutting, patching, finishing and repair work associate with Electrical work, as indicated or required.

1.5 WORK BY OTHERS

A. OWNER-FURNISHED PRODUCTS

1. Where indicated or shown that Owner will furnish products the work of the Contract shall includes providing support systems to receive Owner's equipment, items and assemblies.

2. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.

3. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.

4. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.

5. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.

6. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.

7. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.

8. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect / Construction Manager noting discrepancies or anticipated problems in use of product.

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9. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.

10. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.

11. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.6 CONTRACTOR'S USE OF THE PREMISES

A. The space available to the Contractor for the performance of the work, either exclusively or in conjunction with others performing other construction as part of the project, is shown on the Drawings.

1. Other areas are off limits to all construction personnel.

B. The following building facilities may not be used by construction personnel:

1. Toilet facilities.

2. Food service facilities, including dining areas.

3. Elevator.

C. The Owner will partially occupy the building during the construction period.

1. The Owner will endeavor to cooperate with the Contractor's operations when the Contractor has notified the Owner in advance of need for changes in operations in order to accommodate construction operations.

2. Conduct the work so as to cause the least interference with the Owner's operations.

D. Coordinate with Local Authorities as to which routes are capable of handling heavy truck traffic.

E. Signs: Provide signs adequate to direct visitors.

1. Do not install, or allow to be installed, signs other than specified sign(s) and signs identifying the principal entities involved in the project.

F. All deliveries by the Contractor shall be coordinated with the Owner's Representative/ Construction Manager, prior to the delivery date.

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1.7 PRECONSTRUCTION MEETING

A. A preconstruction meeting will be held at a time and place designated by the Architect/ Construction Manager for the purpose of identifying responsibilities of the Owner's / Architect's / Construction Manager's personnel and explanation of administrative procedures.

B. The Contractor shall also use this meeting for the following minimum agenda:

1. Construction schedule.
2. Use of areas of the site.
3. Delivery and storage.
4. Safety.
5. Security.
6. Cleaning up.
7. Subcontractor procedures relating to:
    a. Submittals.
    b. Change orders.
    c. Applications for payment.
    d. Record documents.

C. Attendees shall include:

1. The Owner / Owner's Representative.
2. The Architect, and any Consultants.
3. Construction Manager.
4. The Prime Contractor and their superintendent.
5. Major Subcontractors, suppliers, and fabricators.
6. Others interested in the work.

1.8 SECURITY PROCEDURES

A. Limit access to the site and building to persons involved in the work.

B. Provide secure storage for materials for which the Owner has made payment and which are stored on-site.

C. Secure completed work as required to prevent loss.

D. The Contractor, and their employees, will be required to be registered with the Owner's Representative / School's Main Office / Construction Manager Office.

1. The Contractor's personnel and Subcontractors will be required to wear identification badges at all times on the site.

END OF SECTION 01010

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SECTION 01020 - ALLOWANCES

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Definitions and Explanations: Certain requirements of the Work related to each allowance are shown and specified in the Bid Documents. The allowance has been established in lieu of additional requirements for that Work, and further requirements thereof (if any) will be issued by change order in accordance with N.J.A.C. 6A:23A-21.1 and N.J.A.C. 5:30-11.

B. The type of allowance scheduled herein for the Work include the following:

1. Lump sum allowance.

C. Selection and Purchase: At the earliest feasible date after the award of the Contract, advise the Architect of the scheduled date when the final selection and purchase of each product or system described by each Allowance must be accomplished in order to avoid delays in the performance of the work. Obtain and submit proposals for the work of each Allowance, as required by the Architect for use in making the final selections; include whatever recommendations for selection may be relevant to the proper performance of the Work. Purchase products and systems as specifically selected (in writing) by the Architect.

1. Submit proposals and recommendations, for the purchase of the products or systems of Allowances, in the form specified for change orders.

D. Change Order Data: Where applicable, include in each change order proposal both the quantity of the products being purchased and the unit cost, along with the total amount of the purchase to be made. Where requested, furnish survey-of-requirements data to substantiate the quantity. Indicate applicable taxes, delivery charges, and amounts of applicable trade discounts.

E. Lump-Sum Allowances: The amounts herein specified are the net amounts available for purchase of the materials specified, including taxes (if any), and each change order amount shall be based thereon. **All other costs associated with the performance of the work under the Allowance, including but not limited to insurance, storage, handling, overhead, profit, etc., are not a part of the allowance, and shall be included in the base bid Contract amount.**

1. In the event the actual purchase amount of materials, plus taxes (if any) exceeds the specified allowance, the Owner will pay the excess; should the actual purchase amount, plus taxes (if any) be less than the specified Allowance, the Contractor shall credit the Owner with the difference.

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2. The actual purchase amount, plus taxes (if any) shall be substantiated by certified bills of sale to be submitted with the change order.

F. Change Order Mark-Up: Except as otherwise indicated, comply with the provisions of the General Conditions and the Supplementary General Conditions.

G. Excess Materials: Submit invoices or delivery slips to indicate the actual quantities of materials delivered to the site for use in fulfillment of each allowance. Where economically feasible, and so requested by the Architect, return unused materials to the manufacturer/supplier for credit to the Owner, after the installation has been completed and accepted. Where not economically feasible to return for credit, and so requested by the Architect, prepare unused materials for the Owner's storage, and delivery to the Owner's storage space as directed. Otherwise, disposal of excess materials is the Contractor's responsibility.

1.2 SCHEDULE OF ALLOWANC(S)

A. General: The following allowance amount is included in the Contract Sum, for the corresponding unit of Work as described.

1. Construction Work
   a. A sum of **$50,000.00** for work not specifically shown on the Drawings, the work shall be performed as directed in the field.

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SECTION 01030 - ALTERNATE BIDS

PART 1 - GENERAL

1.1 PROCEDURE FOR ALTERNATE BIDS

A. Each Bidder shall submit on the Proposal Form, all Alternate Bids applicable to the work under their bid. Alternate Bids shall state the difference in price as "additions to" or "deductions from" the Base Bid, unless otherwise noted, for the substitution, omission, or addition of the following materials, items or construction from that shown and specified.

B. The Alternate Bids, when accepted, become part of the Contract.

C. Each Bidder shall carefully check the Drawings and Specifications to determine the extent of each Alternate Bid required.

D. Alternate Bids shall include all overhead and profit applicable thereto.

E. Alternate Bids shall reflect the increase or decrease in cost of all Work of every name and nature which may be affected thereby and no subsequent claims for extras by reason of the Contractor's failure to observe this requirement will be considered.

F. The description herein for each Alternate Bid is recognized to be incomplete and abbreviated, but implies that each change must be complete for the scope of work affected. Refer to applicable Specification sections and to applicable Drawings, for specific requirements of the Work, regardless of whether references are so noted in description of each Alternate Bid. Coordinate related Work and modify surrounding Work as required to properly integrate with the Work of each Alternate Bid. It is recognized that descriptions of Alternate Bids are primarily scope definitions, and do not necessarily detail full range of materials and processes needed to complete the Work as required.

G. Except as otherwise described or approved, materials and workmanship of the Alternate Bids shall conform to the requirements specified under the various sections of the Specifications for similar items of Work.

H. Where methods of construction, materials, finishes or details of installation required by the various Alternate Bids differ from the requirements shown on the Drawings or specified for corresponding items, the alternate construction, materials, etc. will be subject to approval by the Architect.

I. The Contractor shall submit shop drawings and samples for the Work under each accepted Alternate Bid for approval in conformance with requirements specified for submittals in both Part 1, AIA Document A232 and Section 00800 - Supplementary General Conditions.

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J. The following Alternate Bids shall apply to single overall bids, and must be included in the Bidder's Proposal(s).

1.2 ALTERNATE BIDS - CONSTRUCTION WORK

A. **Alternate Bid No. 1: Epoxy Floor System**

State the amount to be added to the base bid to provide and install the epoxy flooring system in both Gallery A and Gallery B in lieu of the Base Bid flooring system, as shown on various Drawings and as indicated in various Specification sections.

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SECTION 01040 - COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The work of this Section applies to all Construction Bid Documents including drawings, Division 1 - Miscellaneous Requirements Sections, and Specifications Sections included in Part-2 through Part-6.

1.2 REQUIREMENTS INCLUDED

A. Coordination of submittals.

B. Coordination meetings.

C. Coordination drawings.

D. Coordination of project closeout.

E. Administrative/supervisory personnel.

F. Coordination of Trades.

G. Coordination of space.

H. Coordination of field measurements and field conditions.

1.3 GENERAL REQUIREMENTS

A. The Prime Contractor shall coordinate their activities with the activities of other (Sub)Contractors and work performed by others.

B. If necessary, inform each party involved, in writing, of procedures required for coordination; include requirements for giving notice, submitting reports and attending meetings.

1. Inform the Architect when coordination of their Work is required.

1.4 COORDINATION OF SUBMITTALS

A. Coordinate and correlate the submittals on each work item and on interrelated Work items to ensure their timeliness, completeness, consistency, compatibility and compliance with the Bid Documents.

B. Prepare and submit special coordination drawings where close and careful coordination of information is required for proper fabrication or installation of

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materials, products or equipment by separate entities. Coordination drawings may also be required where limited space availability necessitates close and careful coordination for efficient and proper installation of different components.

1. Show interrelationships of components shown on separate shop drawings.

2. Indicate required installation sequences.

3. (See also the requirements for the general coordination drawings under paragraph 1.7 below).

C. Coordinate any request for substitution to ensure compatibility of its space requirements, its operating characteristics and elements and its effects on other Work. Prior to proposing a substitution for any item, verify that its size, configuration, supports and connections will coordinate with all other Work and that it will fit within the allotted space while allowing for proper operating, maintenance and circulation space.

D. Comply with requirements for requests for submittal of substitution indicated in AIA A232 and Section 00800.

1.5 COORDINATION MEETINGS

A. The General Construction Work Contractor shall hold additional coordination meetings and conferences with Prime Subcontractors and others involved in the Work as needed to ensure coordination of Work.

1. Notify the Architect and Construction Manager of such coordination meetings.

B. Regular project site meetings shall be in accordance with Sections 00870 and 01200.

1.6 COORDINATION OF TRADES

A. Coordinate construction activities included under various sections of these Specifications to ensure efficient and orderly installation of each part of the Work and to prevent interferences among parts of the Work. Coordinate work items and construction operations included under different sections of the Specifications that are dependent upon one another for proper installation, connection and operation.

1. Where installation of one part of the Work is interrelated with installation of other components, schedule construction activities in the sequence required to obtain the best results.

2. Where availability of space is limited, coordinate installation of different components to prevent interferences and to ensure proper accessibility for required maintenance, service and repair.

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3. Make adequate provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda outlining special procedures required for coordination. Include such items as required notices, reports and attendance at meetings. Distribute these coordination memoranda to all parties involved in the work being coordinated.

1. Prepare similar memoranda for the Owner and other Contractor(s) where coordination with construction or operations by them is required.

2. Provide copies of such coordination memoranda to the Architect.

C. Coordinate the scheduling and timing of required administrative activities with other construction activities to avoid conflicts and ensure orderly progress of the Work. Administrative activities include:

1. Preparation and updating of schedules.
2. Preparation and processing of submittals.
3. Preparation and processing of requests for information.
4. Project meetings.
5. Testing and inspection activities.
6. Project close-out activities.

1.7 COORDINATION DRAWINGS

A. General Requirements: Prepare coordination drawings where limited space available may cause conflicts in the locations of installed products, and where required to coordinate installation of products.

1. In preparing the coordination drawings, large scale details as well as cross and longitudinal sections shall be developed as required to fully delineate all conditions. Particular attention shall be given to the locations, size and clearance dimensions of equipment items, shafts and similar features.

2. In preparing the coordination drawings, minor changes in duct, pipe or conduit routing that do not affect the intended functions may be made as required to avoid space conflicts, when mutually agreed, but items may not be resized or exposed items relocated or other features affecting the function or aesthetic effect of the building changed without the Architect's prior review and acceptance. It should be assumed that no changes shall be made in any wall or chase locations, ceiling heights, door swings or locations, or other openings. If conflicts or interferences cannot be satisfactorily resolved, then the Architect shall be notified and their determinations obtained. Any conflicts or design deviations shall be specifically identified on Drawings submitted to them.

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3. The coordination drawings shall be submitted, in all cases, in ample time to avoid construction delay. The coordination drawings submitted may lack complete data in certain instances pending receipt of shop drawings, but sufficient space shall be allotted for the items missing, as evidenced by the sign-off of the party responsible for the missing items. When the missing information is available, it shall be promptly incorporated in the composite drawings.

4. Cost and time impacts of relocating any duct, pipe, conduit, or other material that has been installed without proper coordination between all trades involved will be charged to the responsible party. If any improperly coordinated Work or Work installed that is not in conformance with the approved coordination composites necessitates additional Work, the cost and time impacts of all such additional Work shall likewise be the responsibility of the affective party. The Architect shall be the sole judge in determining all responsibilities.

5. All changes in the scope of work due to revisions formally issued and approved shall be shown on the composite drawings.

6. All work on the coordination drawings shall be performed by a competent draftsperson and shall be clear and fully legible. The Architect shall be the judge of the legibility of the composite drawings.

7. In particular, prepare the following coordination drawings:
   a. Drawings showing all piping, duct, cabletrays, and similar items, but not electrical conduit less than 4 inches in diameter.
   b. Complete architectural, mechanical and electrical reflected ceiling layouts, (including ductwork, conduits, piping, lighting, etc.).
   c. Special coordination drawings are to be provided for the following:
      1) Where space is limited, show plan and cross-section dimensions of space available, including structural obstructions and ceilings as applicable.

B. The Prime Contractor shall prepare the coordination drawings required for their work.

C. Layout Drawings: As soon as practical, but in no case starting later than thirty (30) days after the HVACR Work (Sub)Contractor has received the notice to proceed, the HVACR Work (Sub)Contractor shall prepare layout drawings of all duct work and piping at not less than 3/8" scale.

1. These drawings shall show registers, grilles, diffusers and similar features, as well as locations of all units, valves, dampers and other items requiring access for service and maintenance.

2. The drawings shall also show roof, floor and wall openings, reflected ceiling layouts, structural beams, framing and miscellaneous structural steel supports, ceiling heights, walls, floor to floor dimensions, structural columns, doors and

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other major architectural and structural features as shown on the architectural and structural drawings and as per approved shop drawings.

D. Composite Drawings:

1. The HVACR Work Subcontractor shall, as scheduled by the General Contractor, produce a mylar, two (2) prints and one (1) sepia of each layout drawing as described.

2. The sepia will be retained for their records while the mylar and two (2) prints will be formally transmitted to the Plumbing Subcontractor, with copies of the transmittal to the Architect.

3. These drawings must be hand delivered or sent via a reliable mailing service that provides receipts and guarantees 24-48 hour delivery.
   a. Common carrier mailing will not be acceptable.

4. The Plumbing Work Subcontractor, upon receipt of these mylars, will transfer the work from their shop drawings to the mylars, at the same time indicating where conflicts exist between their work and the work already shown on the mylars.
   a. The Plumbing Work Subcontractor will utilize a green colored pencil for the layout of their work.
   b. After completion, the Plumbing Subcontractor will forward the mylars and two (2) prints to the Electrical Subcontractor while retaining a sepia for their records.
   c. The same mailing procedures will pertain.

5. The Electrical Work Subcontractor will duplicate the procedure outlined above, utilizing orange colored pencil for their layout.
   a. After completion the Electrical Subcontractor will forward the drawings as specified above to the Fire Protection Work Subcontractor, (Plumbing Work Subcontractor), if applicable, who will layout their work with a red pencil and, after completion, forward the drawings to the General Contractor, retaining a sepia for their records.

6. The General Construction Work Contractor shall then have the HVACR's instrumentation (ATC) Work Subcontractor review the completed composite drawings and attest to their concurrence that their work can be installed without conflict.

7. The General Construction Work Contractor will schedule coordination meetings on the job site to review the coordination drawings.
   a. These meetings will be attended by a representative from each of the Subcontractors involved in the coordination process.
   b. At these meetings, these Subcontractors will indicate where conflicts exist

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and resolve the conflicts through mutual agreement.

c. Should an impasse occur, the Architect will determine the resolution.

8. When all conflicts are resolved, the Subcontractors will indicate their agreement by signing these final composite drawings.

9. The Drawings shall be signed-off by each of the involved Subcontractors, indicating their awareness of and agreement with the indicated routings and layouts and their interrelationship with the adjoining or contiguous Work. The General Contractor shall then sign these final composite drawings.

10. The final composite drawings shall be completed and signed-off by all parties no later than ninety (90) calendar days after the General Construction Work Contractor has received the Notice to Proceed.
    a. After the final composite drawings have been agreed upon and signed by the Subcontractors and by the General Construction Work Contractor, the General Construction Work Contractor shall provide and distribute prints to each of the Subcontractors, and four (4) sets of prints to the Architect / Construction Manager for reference and record purposes.
    b. The record copies of the signed-off final composite drawings shall be retained by the General Construction Work Contractor and each Subcontractor as working reference documents.
    c. All shop drawings, prior to their submittal to the Architect / Construction Manager, shall be compared with these composite drawings and developed accordingly.
        1) Any revisions to the composite drawings which may become necessary during the progress of the work shall be noted by the General Construction Work Contractor and by each affected Subcontractor and shall be neatly and accurately recorded on their record copies.

11. The General Construction Work Contractor and each Subcontractor shall be responsible for the up-to-date maintenance of their record copies of the composite drawings and for having one up-to-date copy available at the site.

12. The composite drawings, incorporating any subsequent changes thereto, shall be utilized by the General Construction Work Contractor or each Subcontractor in the development of their record drawings.

13. Following sign-off of the final composite drawings, no deviations will be permitted without prior review and acceptance by the Architect.
    a. Unauthorized deviations will be subject to removal and correction at no additional cost to the Owner.

14. In areas where no HVAC work occurs, but where other mechanical and electrical installations are required, each involved Subcontractor shall be

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responsible for their own Work and shall cooperate, as directed by the General Construction Work Contractor, in preparing similar layout and composite drawings.

1.8 COORDINATION OF PROJECT CLOSEOUT

A. Coordinate completion and clean-up work and administrative activities in preparation for Substantial Completion and occupancy of the Work or of designated portions of the Work.

B. After Owner occupancy, coordinate access for completion or correction of the Work not in conformance with the Bid Documents to minimize disruption of Owner's activities.

C. Assemble and coordinate closeout submittals specified in Section 01700.

1.9 REQUIRED ADMINISTRATIVE / SUPERVISORY PERSONNEL

A. General: In addition to the other administrative and supervisory personnel required for the performance of the Work, the Prime Contractor shall provide specific coordinating personnel as specified herein.

B. Project Manager / Superintendent: A full time on site Project Manager, with a recommended minimum of eight (8) years' experience, including project management experience on a similar type of projects.

1. The Contractor for General Construction Work shall provide a full-time staff member or members, (Project Manager/Superintendent), experienced in coordination of mechanical and electrical Work on projects of this type and scale, including administration and supervision.
    a. Responsibilities:
        1) Coordinate all mechanical, plumbing, and electrical Work, and coordinate that Work with the other Work of the project.
        2) Where space is limited, coordinate arrangement of mechanical, electrical, and other Work to fit.
        3) Coordinate cutting and patching activities and sequencing.
        4) Coordinate use of temporary facilities.
    b. Prepare coordination drawings where required and where indicated.
    c. Provide information to the entity preparing the progress schedule.
    d. Participate in progress meetings; report progress, changes required in schedules, and unresolved problems.
    e. Review submittals for compliance with the Bid Documents and for coordination with other Work.
    f. Check field dimensions, clearances, relationships to available space, and anchors.
    g. Check compatibility with equipment, other work, electrical characteristics, and operational control requirements.

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h. Check motor voltages and control characteristics.
i. Coordinate controls, interlocks, wiring of switches, and relays.
j. Coordinate wiring and control diagrams.
k. Review the effect of changes on other Work.
l. Obtain and distribute installation data on each item of equipment requiring mechanical or electrical connections; include:
    1) Electrical power characteristics.
    2) Control wiring requirements.
m. Observe and maintain record of tests and inspections.
n. Observe Work for compliance with Bid Documents and notify the applicable Contractor in writing of observed defects in the Work.
o. Coordinate and observe startup and demonstration of equipment and systems.
p. Coordinate maintenance of record documents.
q. Assist the Architect / Construction Manager with final inspections.

2. Prime Subcontractor(s) shall provide staff for coordination between trades. Staff requirements noted above represent the minimum full-time on site staff required.

3. Staffing is subject to Owner / Architect / Construction Manager's approvals.

4. Staff members may not be removed or replaced without Owner/Architect's approvals.

5. Staff name(s), duties and resumes are to be submitted to the Architect for approval within fifteen (15) days of the Notice to Proceed.

1.10 COORDINATION OF TRADES

A. Coordinate Work with other trades to eliminate any possible interference before any piping, conduit, equipment, devices, controls, supports, ductwork and fixtures are installed.

B. Where multiple items of mechanical and electrical equipment, devices, piping, conduits, supporting metal work, hangers, pull boxes, outlets, ductwork or controls are shown on any of the Bid Documents of the various trades in the same location, coordinate and adjust items to fit within designated location(s).

C. Provide and install necessary offsets, bends, turns and modifications in piping, ductwork, conduit and devices required to install the Work without interference with that of other trades or structure, without additional cost to the Owner.

D. For products specified to be furnished by one Contractor and installed by another Contractor:

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1. Contractor specified to furnish (or remove) product shall be responsible for delivery to (or return from) the project site, and shall pay transportation costs.

2. Contractor specified to install product shall be responsible for coordinating product delivery, loading or unloading, storing, protecting and installing product as required.

1.11 COORDINATION OF SPACE

A. Coordinate use of available space and sequence of installation for work (e.g., mechanical and electrical work) which is indicated diagrammatically or schematically on the Drawings. Prevent physical interference of components. Follow routing shown for pipes, ducts and conduits, taking into account the limitations of available space; make runs parallel with lines of building. Utilize space efficiently to ensure proper installations (including installation of other Work) and accessibility for maintenance, service and repairs.

B. Detailed Drawings of proposed departures from spatial arrangements or locations indicated in the Bid Documents, due to field conditions or other causes, shall be submitted to the Architect for review. No such departures shall be made without prior review by the Architect.

C. Where required for coordination, the Architect will have the authority to order, as changes in the Work, changes in locations and sizes of piping, ductwork conduit, raceways and ducts. Such changes shall be made without adjustment to the Contract Sum or Contract Time.

D. Field verify measurements of existing items and work which precedes each sequence. Ensure proper fit and location.

E. In finished areas, conceal pipes, ducts and wiring in the construction.

F. Coordinate locations of fixtures and outlets with finish elements.

1.12 COORDINATION OF FIELD MEASUREMENTS AND FIELD CONDITIONS

A. Prior to ordering materials or equipment or performing work, the Contractor and/or Subcontractors shall verify Bid Documents and submittal of dimensions and weights affecting their Work and other Prime Contractor's Work associated with field measurements and field conditions at the project site, (for building Work), and shall be responsible for their accuracy and correctness.

B. Differences discovered from dimensions or weights indicated in the Bid Documents or submittals shall be submitted in writing to the Architect for review, before proceeding with the Work.

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C. Commencing Work implies acceptance of surfaces, areas, preceding Work and other field conditions, and verification of dimensions, by the Contractor.

D. No Change Order will be issued in cases where discrepancies in dimensions are discovered after Work has been commenced or where the Contractor has failed to properly investigate and take into account field measurements and existing field conditions.

E. Inspection of Conditions: Require the Installer of each major component to inspect both substrate and conditions under which their work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

F. Recheck measurements and dimensions, before starting each installation.

1. Submit to the Architect for review any change in dimensions shown on the Bid Documents or submittals affecting physical size, shape or location of any part of the Work, whether due to field conditions or other causes.

G. Passage of Equipment:

1. Establish passage clearances required to deliver, install and erect mechanical and electrical equipment. Wherever necessary, provide equipment in sections or knocked down in order to allow passage of equipment through available openings.

2. Where there is not sufficient clearance for passage of mechanical or electric equipment, deliver, install and protect such equipment before confining walls, floors, slabs and steel Work are erected. Schedule and coordinate this Work with the Work of other Trades.

3. If any structure, equipment or system must be altered to allow passage of equipment, the person or entity responsible for providing that structure, equipment, or system shall restore it to its original condition, without additional cost to the Owner.

4. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Bid Documents.

H. Verify the size of shafts and chases, the adequacy of partition thickness and the clearance in double partitions and hung ceilings for proper installation of Work.

1. (Sub)Contractors shall cooperate in arranging their Work with other (Sub)Contractors whose Work is in the same spaces.

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2. The amount of space occupied by each trade's Work shall be kept to the minimum required.

3. Arrange for chases, slots and openings in other building components during progress of construction, to allow for timely installation of Work.

I. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

J. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.

K. Provide all appropriate structural supports, hangers, wires for roof, floor and wall and associated assemblies which include but are not limited to materials, finishes, equipment, fixtures, piping, raceways, mechanical and electrical components. This Work shall be in conformance with requirements of the Bid Documents whether or not indicated by a reference in specification or as may be in detail shown on Drawings and schedules.

L. Visual Effects: Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.

M. Install each component during weather conditions and construction status that will ensure best possible results. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.

N. Coordinate temporary enclosures with required inspections and tests, to minimize necessity of uncovering completed construction for that purpose.

O. Where mounting heights are not indicated:

1. Install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

2. Install mechanical and electrical systems, materials and equipment to provide maximum possible headroom. Maintain maximum headroom and space conditions. Where headroom or space conditions (less than 8'-0") appear inadequate, the Architect shall be notified before proceeding with the Work.

END OF SECTION 01040

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SECTION 01050 - ALTERATIONS, CUTTING, PATCHING AND REFINISHING WORK

PART 1 - PRODUCTS

1.1 RELATED DOCUMENTS

A. The Work of this Section applies to all Construction Bid Documents including Drawings, Division 1 - Miscellaneous Requirements Sections and Specifications Sections included in Part-2 through Part-6.

1.2 DESCRIPTION

A. Work included: Alterations, removals and demolition required for this Work include, but are not necessarily limited to:

1. Alterations, cutting, patching, removal and preparation Work to be done as noted on Drawings, as required, to complete construction.

2. Patching and refinishing of existing surfaces damaged or left unfinished as a result of this Work, including site work, existing ground surfaces, concrete surfaces, bituminous paving surfaces, etc.

3. Asbestos.
   a. The Contractor shall review and familiarize themselves with the Owners Asbestos Hazard Emergency Response Act (AHERA) report prior to the commencement of any demolition activity. Also, the Contractor will be provided with an inventory of all ACM (Asbestos Containing Materials) in the building(s) where they are working, and will be required to sign a form (provided by the Owner) that they are in receipt of the inventory.
   b. Contractor is herein cautioned that asbestos may be within concealed spaces where Work will be taking place. The Contractor shall immediately notify the Owner if any concerns or conditions arise in regards to potential asbestos containing building materials (ACBM's) in order that the Owner may verify same and take appropriate action. The Contractor shall not proceed with the Work until the material has been abated and air sampling clearance levels have been achieved as set forth by the Owner's Environmental Consultant.
   c. The Contractor shall employ personnel who are trained in accordance with OSHA workplace standards as they pertain to asbestos.
   d. **The Architect / Engineer has no authority or professional involvement relative to the hazardous material/asbestos removal or disposal phase for this project and are not available for questions and/or direction in this regard. The hazardous material/ asbestos reference is included as a convenience for the Owner, and the Architect accepts no responsibility nor liability for the accuracy of information, Bidders conclusions, methods to be used, nor for any aspect of approvals required by the Contractor in undertaking and completing this project insofar as**

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hazardous material/asbestos is concerned. The Contractor shall direct any/all questions and concerns to the Owners Hazardous Material Abatement Consultant.

e. Worker and Community Right to Know Act Requirements
   1) It is required that the Contractor and/or Subcontractors comply with all of the requirements of HAZCOM 2012 and New Jersey Right To Know (RTK) program. Prime Contractor is responsible for ensuring that containers of substances belonging to the Contractor and/or Subcontractors that are stored at the Owner's facility are properly RTK labeled. Refer to N.J.A.C. 8:59-5.10.
   2) Surveys of hazardous substances stored at the Owner's facility by the Contractor and/or Subcontractor are to be provided to the Owner of the facility. Refer to N.J.A.C. 8:59-2.2(h).
   3) Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS) from manufacturers must be provided to the Owner for all products present at, purchased for, and brought on site by Contractors and/or Subcontractors to the Owner's facility. Refer to N.J.A.C. 8:59-2.2(1).
   4) Contractor and/or all Subcontractors must submit, prior to starting any Work, a copy of their approved Hazard Communication Plan - 29 CFR 1910.1200.

4. This project shall be subject to the requirements of the EPA "Renovation, Repair and Painting" rule including the following:
   a. The Contractor must be lead safe trained and certified. The Contractor will be required to submit a copy of their EPA certificate prior to the start of the Work.
   b. The Contractor shall provide the Owner with a copy of the EPA's Lead Hazard Management information pamphlet "Renovate Right-Important Lead hazard Information for Families, Child Care Providers and Schools" prior to the start of any renovation Work. The Contractor shall have the Owner sign a pre-renovation disclosure form confirming receipt of the pamphlet.
   c. The Contractor shall at all times employ lead safe practices as identified in the rules.

5. This project shall be subject to the requirements of the EPA rules on diesel exhaust and off-site particulate dust, including the following:
   a. Diesel exhaust contributes the highest cancer risk of all air toxics in New Jersey and is a major source of NOx within the state. Therefore, per NJ DEP recommendations, construction projects involving non-road diesel construction equipment operating in a small geographic area over an extended period of time shall implement the following measures to minimize the impact of diesel exhaust:
      1) All on-road vehicles and non-road construction equipment operating at, or visiting, the construction site shall comply with the three minute idling limit, pursuant to N.J.A.C. 7:27-14 and N.J.A.C. 7:27-15. Contractor shall purchase "No Idling" signs to post at the site to

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remind Subcontractors to comply with the idling limits. Signs are available for purchase from the Bureau of Mobile Sources at 609/292-7953 or http://www.stopthesoot.org/sts-no-idle-sign.htm.

2) All non-road diesel construction equipment greater than 100 horsepower used on the project for more than ten days shall have engines that meet the USEPA Tier 4 non-road emission standards, or the best available emission control technology that is technologically feasible for that application and is verified by the USEPA or the CARB as a diesel emission control strategy for reducing particulate matter and/or NOx emissions.

3) All on-road diesel vehicles used to haul materials or traveling to and from the construction site shall use designated truck routes that are designed to minimize impacts on residential areas and sensitive receptors such as hospitals, schools, daycare facilities, senior citizen housing, and convalescent facilities.

b. Contractor will be liable for the effects of off-site particulate dust and/or odors during construction and shall take steps to minimize the impact of air pollution from these activities.

6. **Hot Work Permit**:

a. A Hot Work Permit is required for any operation involving "open flame" or "producing heat and/or sparks".

1) This Work includes, but is not limited to, welding, brazing, cutting, grinding, soldering, thawing pipe, torch-applied roofing, or chemical welding.

b. Before initiating hot Work, ensure precautions are in place as required by NFPA 51B and ANSI Z49.1.

c. Make sure an appropriate fire extinguisher is readily available.

B. Related Sections:

1. Section 00870 - Miscellaneous Requirements.

2. Section 01010 - Summary of the Work.

3. Section 01020 - Allowances.

4. Section 01040 - Coordination.

5. Section 02070 - Selective Demolition.

6. **Division 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.**

a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

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1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Location and Extent of Work: Submit key plan indicating room location where Work to take place. Describe cutting and patching, indicate methods and show how they will be performed.

2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.

3. Products: List products to be used and firms or entities that will perform the Work. Provide samples and field mock-up as indicated or requested by the Architect.
   a. Samples and field mock-up shall match existing surfaces and colors.
   b. Obtain Architect's approval prior to proceeding with Work.

4. Schedule and Dates: Provide Work schedule, indicate when cutting and patching will be performed.

5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Coordinate cutting of operating elements with other plumbing, HVAC, electrical or other trades.

C. Miscellaneous Building Elements: Do not cut and patch any building elements or related components in a manner that could change their operation, load-carrying

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capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. Engage experienced installers or fabricators for all Work.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

F. Mock-Ups: Provide mock-ups for Architect / Construction Manager approval for each proposed patching method. Do not proceed with patching Work until obtaining of approvals from the Architect / Construction Manager.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties. Confirm existing warranties with Owner prior to starting of Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

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1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

B. Inspection:

1. Prior to start of any Work the General Construction Work Contractor shall verify all existing work area conditions; building lines, lengths, corners and all other dimensions.
   a. Copies of all surveys performed by the General Contractor shall be submitted to the Architect in two copies and shall include layout Drawings and data sheets.

2. The General Construction Work Contractor shall submit information and survey to Prime Work Subcontractors, the Architect / Construction Manager for all required coordination of new construction and all other related Work.

3. Prior to Work of this section, verify information and survey submitted by the General Construction Work Contractor, carefully inspect the existing conditions and verify that materials and surfaces to be altered or removed are the same as noted on the Drawings.

C. Discrepancies:

1. In the event of discrepancy of existing conditions, surfaces, etc., immediately notify the Architect and the Construction Manager.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

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3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. The Contractor shall provide cutting, patching, relocations, and or re-installations of existing construction to provide for installation of other components or performance of other construction associated with their Work, and subsequently patch and finish, as required, to restore surfaces to their original condition. Work shall be performed whether or not shown on Drawings.

2. The General Construction Work Contractor shall provide all required and necessary pockets in concrete and masonry walls and in roof assemblies including all required cutting, and preparation Work to allow for installation of new structural steel framing, supports, lintels, bearing plates, dunnage, etc. The General Construction Work Contractor shall subsequently patch, as required, to restore and prepare surfaces to receive new finishes.
   a. Cutting roof decking, roof flashing, patching and associated roofing Work in existing building, where no roofing replacement is indicated or required, shall be performed by the Prime (Sub)Contractor for Work included under the Contract.

3. All repairing, patching, piecing out, filling in, restoring and refinishing shall be neatly done by craftsworkers skilled in their respective trades and completed in proper manner to leave same in condition satisfactory to the Architect.

4. All new Work shall be installed plumb, level, true, and shall be shimmed as required to cover any irregularities in substrates.

B. Cutting:

1. Before cutting is started in any location the Contractor shall carefully investigate conditions as to human and structural safety, existing piping, wiring and items concealed, and wherever same interfere with the Work they shall be properly relocated, rerouted or removed as the case may be, at no increase to Contract price.

2. Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

3. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to

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size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

4. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

5. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

6. Do not disturb any structural Work, plumbing, steam, gas, or electric Work without approval of Architect.

7. Mechanical and Electrical Services:
   a. Cut off pipe or conduit in walls or partitions to be removed shall be performed by respective trade.
   b. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting shall be performed by respective trade.

8. Proceed with patching after construction operations requiring cutting are complete.
   a. Remove, cut, alter, replace, patch and repair existing Work as necessary to install new Work.

9. Existing Work disturbed or removed as a result of performing required new Work, shall be patched, repaired, reinstalled or replaced with new Work, and refinished and left in as good condition as existing before commencing Work.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Field Mock-up: Prepare field mock-up of proposed restoration method as requested or required by the Architect. Obtain Architect's approval prior proceeding with actual Work.

3. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate or minimize evidence of patching and refinishing.

4. Floors and Walls: Where walls, partitions and/or built-in cabinets that are removed extend one finished area into another, patch and repair floor and wall

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surfaces in the existing and new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

5. Ceilings: Cut, remove, patch, repair, install new including hanging assemblies and finish ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 CLEAN-UP

A. Areas where demolition is in progress within or adjacent to Owner occupied areas shall be broom cleaned at the end of each working day.

B. Do not burn materials or debris on premises.

C. Do not allow demolished materials to accumulate inside or outside of existing building.

D. Remove from the site all rubbish and debris resulting from Work of this section.

E. If the Contractor fails to clean-up their debris within 24 hours, the Owner has the right to clean-up the debris left by the Contractor(s). All associated clean-up costs, incurred by the Owner, will be back-charged to the Contractor.

3.5 PROTECTION

A. Contractor shall provide all other necessary temporary enclosures, guardrails, barricades, etc. to adequately protect all workers and public from possible injury. Provide all necessary temporary partitions, enclosures, coverings of approved materials and construction for the exclusion of weather and for confining dust and debris.

B. Contractor shall be responsible for the protection of the existing building, facilities and improvements within the areas where Work is being done. Any disturbance or damage to the Work, the existing building, and improvements, equipment or any impairments of facilities resulting from their Work, shall be promptly restored, repaired, or replaced by the responsible Contractor at no extra cost to the Owner.

C. Adequate protection of persons and property shall be provided at all times, including Saturdays, Sundays and holidays, and during time Work is being performed and after working hours. Protection shall include barricade fencing, traffic control, dust partitions, weather protection and other means, as required.

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D. Preserve and protect all existing vegetation such as trees, shrubs, and grass on or adjacent to the site and along access to the site. Be responsible for all unauthorized cutting or damaging of trees and shrubs, including damage due to careless operation of equipment, stock-piling of materials or tracking of grass areas by equipment.

3.6 SALVAGE

A. Partial Removal: Items of salvable value to Contractor may be removed from structure as Work progresses. Salvage items must be transported from site as they are removed.

1. Storage or sale of removed items on site will not be permitted.

B. Items designated on Drawings or in Specifications to remain the property of the Owner, or to be reused, shall be removed, and securely stored with care to prevent damage. Repair or replace such items damaged in removal.

C. Before transporting non-designated, removed items from the site, contact Architect/ Construction Manager for decision as to what items if any are to remain the property of the Owner. Items retained by the Owner will be transported by them to their storage area.

3.7 STANDARDS

A. All demolition Work shall be performed in accordance with the applicable rules and regulations and the Codes and Ordinances of local, State and Federal authorities, and in accordance with the requirements of public utility corporations.

B. Work shall satisfy requirements of the Occupational Safety and Health Act of 1970 with amendments.

C. Work not affected by more stringent requirements of regulatory agencies shall satisfy the provisions of ANSI-A10.6-2006 (R2016) - American National Standard Safety Requirements for Demolition.

D. Confine the movement and storage of vehicles, equipment and materials to such routes and locations as may be designated by the Owner and Architect.

E. The building and grounds will be maintained in a clean and orderly manner so as to conform with all local fire safety regulations and in accordance with the latest editions of the Safety Code of the National and State Board of Fire Underwriters.

3.8 INGRESS, EGRESS AND CIRCULATION

A. The Prime Contractor shall be responsible for performing their construction activities in such manner to maintain ingress and egress for visitors and occupants of Owner-

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occupied areas and to continuously maintain all required emergency exits from and circulation between existing facilities. Passageways for emergency exits shall be kept continuously free from debris, construction equipment, tools, stockpiles or materials, and other hazards to speedy evacuation. The Contractor shall provide all necessary temporary Work as prudence and good practice may dictate and in accordance with Applicable Law and Authorities Having Jurisdiction to obtain and maintain all such ingress, egress and circulation requirements. The Prime Contractor shall be responsible for providing coordination of this temporary Work between Subcontractor(s), as directed by the Architect. All temporary Work shall be removed when no longer required.

3.9 NON-INTERFERENCE WITH OWNER'S OPERATIONS

A. Work under this Contract will be performed when the existing building is occupied. Coordinate with Owner's schedule and operation, obtain Owner's / Construction Manager's approval prior to proceeding with Work.

B. Contractor shall acquaint themself with the general character of the Owner's operations prior to commencing Work and shall schedule their Work to avoid interference therewith. The sequence of alteration operations shall be in accordance with a schedule of Contract operations approved by the Owner and Architect and Construction Manager.

C. The Contractor shall not start Work until the schedule has been approved in writing by the Architect, Construction Manager and the Owner.The Contractor shall not perform Work in occupied areas without giving the Owner 72 hours written notice of their intention to Work in occupied areas.

D. The Contractor shall expedite placing orders and submission of shop drawings for equipment required to complete Work under this Contract to ensure delivery of all equipment with adequate time allowed to complete the installations to conform to the project completion date.

END OF SECTION 01050

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SECTION 01151 - UNIT PRICES

PART 1 GENERAL

1.1 PROCEDURE

A. Bidder shall insert on the Proposal Form, all Unit Prices applicable to the Work under their bid. Unit Prices will be used as the basis for computing "additions to" or "deductions from" the Contract Price for extra work and for work countermanded, reduced or omitted.

B. Except as otherwise provided in the General Conditions, the Unit Prices when accepted, adjusted or established by the Contract shall remain binding and irrevocable for the entire period of the Contract, regardless of the quantities of Work ordered or required under such Unit Prices.

C. The acceptance of the Unit Price is on condition that the general character of the material and workmanship required for any Work related thereto shall be equivalent to corresponding Work as shown and specified, and that all costs, overhead and profit, as well as all incidental Work required in connection therewith, has been included in the Unit Price.

1.2 UNIT PRICES - GENERAL CONSTRUCTION: Materials in Place.

Cement Based Self Leveling Underlayment per Section 03452 $_____ per sq. ft.

1.3 UNIT PRICES - PLUMBING & FIRE SUPPRESSION: Materials in Place.

2″ cast iron pipe below grade $_____ per lin. ft.

3″ cast iron pipe below grade $_____ per lin. ft.

4″ cast iron pipe below grade $_____ per lin. ft.

2" cast iron above grade $_____ per lin. ft.

1/2″ Type ‘L’ copper tubing $_____ per lin. ft.

3/4″ Type ‘L’ copper tubing $_____ per lin. ft.

2″ Type ‘L’ copper tubing $_____ per lin. ft.

1/2" piping insulation $_____ per lin. ft.

3/4" piping insulation $_____ per lin. ft.

2" piping insulation $_____ per lin. ft.

1/2" Ball valve $_____ per unit

1-1/2" Ball valve $_____ per unit

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2" Ball valve $_____ per unit

Thermostatic mixing valve MV-1 $_____ per unit

Water Heater $_____ per unit

Sewage Ejector $_____ per unit

Floor drain FD-1 $_____ per unit

Sprinkler head with associated 1″ branch piping (approx.. 5′-0″ length) $_____ per unit

1.4 UNIT PRICES - HEATING AND VENTILATING: Materials in Place.

3/4″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints $_____ per lin. ft.

3/4" piping insulation $_____ per lin. ft.

1″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints $_____ per lin. ft.

1" piping insulation $_____ per lin. ft.

1 1/2″ Type 'L' copper with brazed joints or Sch 40 Steel pipe, Class 150 w/ Threaded Joints $_____ per lin. ft.

1 1/2" piping insulation $_____ per lin. ft.

Condensate pump $_____ each

12"X8" Volume damper $_____ each

24″x24″ ceiling diffuser $_____ each

24″x24″ ceiling register $_____ each

24″x12″ ceiling registers $_____ each

24″x14″ Supply Grilles $_____ each

Unitary controller $_____ each

Thermostat $_____ each

Ball valve, under 1″ $_____ each

Ball Valve, 1″ $_____ each

Ball Valve, 1 ½″ $_____ each

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Balancing Valve, 1″ $_____ each

Balancing Valve, 1 ½″ $_____ each

Galvanized Steel Ductwork (Rectangular) 20"X12" $_____ per lb.

Single-Wall Round Ductwork 12" diameter $_____ per lb.

Double-Wall Round Ductwork 12" diameter $_____ per lb.

1 1/2" Mineral-Fiber Board Duct Insulation (Indoors) $_____ per sq. ft.

2" Mineral-Fiber Blanket Duct wrap Insulation (Indoors) $_____ per sq. ft.

2" Mineral-Fiber Board Duct Insulation (Outdoors) $_____ per sq. ft.

1.5 UNIT PRICES - ELECTRICAL: Materials in Place.

20A-1 Pole branch circuit installation 600V, including MC cable and termination. $_____ per lin. ft.

20A-1 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

30A-3 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

50A-3 Pole branch circuit installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

60A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

70A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

80A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

90A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

100A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

150A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

200A-3 Pole feeder installation 600V, including EMT conduit, THHN wire, and termination. $_____ per lin. ft.

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20A Tamper-resistant receptacle including back box, plate, conduit and wiring to the nearest device(20') $_____ each

20A Tamper-resistant GFCI receptacle including back box, plate, conduit and wiring to the nearest device(20') $_____ each

20A Single pole light switch including back box, plate, conduit and wiring to the nearest device(20') $_____ each

20A Single pole three way light switch including back box, plate, conduit and wiring to the nearest device(20') $_____ each

Fire Alarm smoke/heat detector including wiring, programming, and testing. $_____ each

Fire Alarm duct smoke detector including wiring, programming, and testing. $_____ each

Fire Alarm Horn/strobe including wiring, programming, and testing. $_____ each

Fire Alarm monitor/control module including wiring, programming, and testing. $_____ each

Fire Alarm door holder including wiring, programming, and testing. $_____ each

Fire Alarm Pull station including wiring, programming, and testing. $_____ each

Fire Alarm Device Wire mesh device guard. $_____ each

Junction Box and 3/4" Empty conduit with drag line and bushing at each end $_____ per lin. ft.

Junction Box and 1" Empty conduit with drag line and bushing at each end $_____ per lin. ft.

Junction Box and 2" Empty conduit with drag line and bushing at each end $_____ per lin. ft.

(1) Ceiling mounted occupancy sensor as indicated on contract drawings. $_____ each

(1) Wall switch occupancy sensor as indicated on contract drawings. $_____ each

Combination Voice & Data communication outlet including backbox, wall plate, conduit, and Cat6 cable to IDF room $_____ each

END OF SECTION 01151

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SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:

1. Pre-Construction Conference
2. Pre-Installation Conferences
3. Coordination Meetings
4. Progress Meetings

B. Construction Schedule requirements is specified in another Division 1, Section.

1.3 PRE-CONSTRUCTION CONFERENCE

A. The Architect will schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than fifteen (15) calendar days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Architect, Construction Manager and their consultants, the Prime HVAC Contractor and their superintendent, major Subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could effect progress including such topics as:

1. Tentative construction schedule
2. Critical work sequencing
3. Designation of responsible personnel
4. Procedures for processing field decisions and Change Orders
5. Procedures for processing Applications for Payment
6. Distribution of Bid Documents
7. Submittal of Shop Drawings, Product Data, and Samples
8. Preparation of record documents
9. Use of the premises

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10. Office, Work, and storage areas
11. Equipment deliveries and priorities
12. Safety Procedures
13. First Aid
14. Security
15. Housekeeping
16. Working hours

1.4 PRE-INSTALLATION CONFERENCES

A. The Prime Contractor to conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The installer and representative of manufacturers and fabricators 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 the Architect and Construction Manager of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
    a. Bid Documents
    b. Options
    c. Related change orders
    d. Purchases
    e. Deliveries
    f. Shop Drawings, product data and quality control samples
    g. Possible conflicts
    h. Compatibility problems
    i. Time schedules
    j. Weather limitations
    k. Manufacturer's recommendations
    l. Compatibility of materials
    m. Acceptability of substrates
    n. Temporary facilities
    o. Space and access limitations
    p. Governing regulations
    q. Safety
    r. Inspection and testing requirements
    s. Required performance results
    t. Recording requirements
    u. Protection

2. Record significant discussions and agreements and disagreements of each conference along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner, the Architect and the Construction Manager.

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3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 COORDINATION MEETINGS

A. The HVAC Contractor will conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 PROGRESS MEETINGS

A. Regular Progress Meetings: The Construction Manager will schedule and conduct regular progress meetings as follows:

1. Weekly meetings with the Contractor and Subcontractors.

2. Bi-weekly meeting with the Owner, Architect, Contractor and Subcontractors.
   a. Weekly meetings between the Contractor and Subcontractors will be the responsibility of the Contractor and the Architect will not attend.

B. Special Meetings will be conducted as required by the progress of the Work

C. Location of the meetings: Meetings shall be conducted at a location in the school to be determined by the Owner's Representative.

D. Attendance: Attendance at Construction Meetings shall be as follows:

1. The Owner shall be in attendance at bi-weekly meetings and at any special meetings as appropriate to the agenda.

2. The Construction Manager, Architect and their professional consultants, as needed, at bi-weekly meetings and at any special meetings as appropriate to the agenda.

3. The Contractor at all construction meetings.

4. Subcontractors as appropriate to the agenda.

5. Suppliers as appropriate to the agenda.

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6. The Owner's Representative at all construction meetings.

E. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.

F. Contractor's Construction Schedule:

1. Review the present and future needs of each entity present, including such items as:
   a. Interface requirements
   b. Time
   c. Sequences
   d. Deliveries
   e. Off-site fabrication problems
   f. Access
   g. Site utilization
   h. Temporary facilities and services
   i. Hours of work
   j. Hazards and risks
   k. Housekeeping
   l. Quality and work standards
   m. Change orders
   n. Documentation of information for payment requests

G. Reporting: No later than three (3) business days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

H. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

I. Attendance by the Contractor is mandatory, whether the meetings are weekly, bi-weekly or at whatever interval is determined by the Architect and the Construction Manager.

1. Unless given prior approval by the Construction Manager / Architect in writing not to attend meetings, Contractor will be fined **$250.00** for each regularly scheduled meeting for which they are not represented by a person in authority who can speak for and/or make decisions for the Contractor.

2. Fine amounts shall be withheld and deducted from the Contract Sum.

END OF SECTION 01200

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SECTION 01325 - CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Work included: To assure adequate planning and execution of the Work so that the completion of the Work is within the time proposed and allowed in Section 01800 and other documents in the Contract, and to assist the Owner in appraising the reasonableness of the proposed schedule and in evaluating progress of the Work, prepare and maintain the schedules and reports described in this section.

B. Preliminary Construction Schedule ("Construction Summary by Phase") and Phasing Plan:

1. The preliminary project schedule provided herein is intended to be used as a guide by the Contractor during the Bidding and the Construction Phases.

2. The Construction Manager, the Architect and the Owner will not be held liable for the scheduled activity durations identified in the schedule.

3. The Phasing Plan provided with Bid Documents is intended to provide the Contractor with a basis for scheduling construction to satisfy Owner's requirements.

1.2 QUALITY ASSURANCE

A. Qualifications of Scheduling Personnel: Employ a scheduler who is thoroughly trained and experienced in compiling construction schedule data, in analyzing by use of Critical Path Method or PERT, and in preparation and issue of periodic reports as required below.

B. Reference Standards: Perform all data preparation, analysis, charting, and updating in accordance with all recommendations contained in the current edition of "CPM in Construction" Manual of Associated General Contractors, (or in accordance with other standards approved).

C. Reliance upon Approved Schedule:

1. The Contractor's CPM construction schedule shall be an integral part of the Contract, shall incorporate the milestone Contract Completion dates specified elsewhere in the Bid Documents (Section 01800), for each Building/Phase, and shall establish interim completion dates for all construction activities related to each Phase.

2. It is the responsibility of the Contractor to obtain all necessary information from Prime Subcontractors, Suppliers, the Owner, Architect, Engineers, Owner's Representative, and any other entities with whom the schedule must be coordinated.

3. Should any activity not be completed within 7 calendar days after its scheduled completion date, the Owner shall have the right to order the Contractor to expedite completion of the activity by whatever means the Owner deems appropriate and necessary, without additional compensation to the Contractor.

4. Should any activity be 15 or more calendar days behind schedule, the Owner shall have the right to perform the activity or have the activity performed by whatever method the Owner deems appropriate.

5. The Contractor shall reimburse any costs incurred by the Owner in connection with expediting construction activity under this Article to the Owner.

6. It is expressly understood and agreed that failure by the Owner to exercise the option to either order the Contractor to expedite an activity or to expedite the activity by other means shall not be considered precedent setting for any other activities, nor shall it relieve the Contractor of the obligation to complete the Work of each Phase by the Contract milestone date.

1.3 SUBMITTALS

A. General: Comply with the provisions set forth herein.

B. Coordination: The Contractor shall be responsible for preparation/submission of all scheduling documents. The Prime Subcontractors shall provide the Contractor information required to prepare the Preliminary Analysis, Construction Schedule and Periodic Reports. Failure of any one or more Prime Subcontractors to provide information requested in a timely manner shall result in the Owner withholding payments until such information is provided.

C. Preliminary Analysis: Within ten (10) calendar days after issuance of Notice to Proceed, submit one electronic copy, one reproducible copy and four prints of a preliminary construction schedule prepared in accordance with Part 3 of this Section.

Note: No initial Application for Payment will be approved for payment prior to submission of these items.

D. Construction Schedule: Within fifteen (15) calendar days after issuance of Notice to Proceed, submit one electronic copy, one reproducible copy and four prints of construction schedule prepared in accordance with Part 3 of this Section.

Note: No second Application for Payment will be approved for payment prior to submission of and approval of the Contractor's Construction Schedule.

E. Periodic Report:

1. On the first working day of each month following submittal described in Paragraph D. above, submit one electronic copy and four prints of the construction schedule updated as described in this Section.

2. On a weekly basis, on the day determined at the Pre-Construction Meeting, submit the Weekly Status Report updated and described in this Section.

F. Processing of future Applications for Payment shall be conditioned upon timely submission of Periodic Reports.

PART 2 - PRODUCTS

2.1 CONSTRUCTION ANALYSIS

A. The Contractor's Construction Schedule shall be prepared using Primavera Project Planner (latest version) software by Primavera Systems, Inc. or other scheduling software approved

in advance by the Construction Manager. The Contractor shall provide copies of all required items on paper media as well as on hard disk.

1. In the event the Contractor receives approval to utilize a scheduling software other than Primavera Project Planner latest Version, the Contractor shall provide, at no additional cost to the Owner, one licensed copy of such software, in the unopened original packaging with all documentation, original software and manuals.

B. Logic Diagram: Graphically show the order and interdependence of all activities necessary to complete Work, and the sequence in which each activity is to be accomplished as planned by the Contractor and the project field superintendent in coordination with all Prime Subcontractors whose Work is shown on the diagram. Activities shown on the diagram shall include, but are not necessarily limited to:

1. Project mobilization;

2. Project Phasing and Milestones;

3. Submittals and approvals of Shop/ Coordination Drawings, Color Selections and Samples;

4. Procurement of equipment and critical materials (required for any item with a lead time exceeding 20 calendar days);

5. Fabrication of special material and equipment and their installation and testing;

6. Activities corresponding to entries on the Schedule of Values in accordance with E. below;

7. Inspections by the Local Construction Office and Testing and Inspection by the Contractor's consultant;

8. Required Pre-Installation Meetings;

9. Building Enclosure (temporary and permanent) and required heat/ climate control;

10. Completion and occupancy of individual phasing areas per Phasing Plan;

11. Final clean-up;

12. Final inspection and testing;

13. All activities by the Owner's or Owner's separate Contractor(s) that effect progress, required dates for completion, or both, for all and for each part of the Work.

C. The detail of information shall be such that duration times of activities shall normally range from one to twenty days (except for long lead fabrication and delivery activities as required herein). The selection and number of activities shall be subject to the Owner's approval.

1. Show on the diagram, as a minimum for each activity, preceding and following activity numbers, description of each activity, cost, and activity duration in calendar days. Submit diagram on a sheets 24-30 inches high by 36-42 inches wide required.

2. Mathematical Analysis: Furnish a mathematical analysis of the diagram by computer-aided means, including a tabulation of each activity. Show the following information as a minimum of each activity:
    a. Preceding and following activity number(s);
    b. Activity descriptions;
    c. Earliest start date (by calendar date);
    d. Latest start date (by calendar date);
    e. Earliest finish date (by calendar date);
    f. Latest finish date (by calendar date);
    g. Total float (by calendar days);
    h. Monetary value of the activity;
    i. Percentage of activity completed;
    j. Contractor's earning based on portion of activity completed.

D. The means used in making the mathematical analysis shall be capable of compiling the total value of completed and partially completed activities, and be capable of accepting modifications approved for time and logic adjustments.

E. Cost Loading of Schedule: The Contractor's Construction Schedule shall be "cost-loaded" such that the schedule shall reflect the planned sequence of Work and billing of the Contract and shall be coordinated with the schedule of values as otherwise required. On a monthly basis, the value of any monthly Application for Payment shall conform to the value of Work completed as reflected on the Monthly Project Schedule Updates.

F. Periodic Reports: List all activities in computer printouts, sorted as follows:

1. By the activity identification number (overall and by phase/area).
2. By the amount of total float.
3. By early start, then by early finish and then by total float.
4. Provide a hard disk copy of the Periodic Reports required.
5. Other sorts requested by the Owner.

2.2 WEEKLY STATUS REPORTS

A. Format: The Contractor shall submit weekly status reports in the form supplied at the Pre-Construction Meeting to provide sufficient pertinent data to determine that Work and materials procurement flow is adequate for all needs of the Work.

B. Content: Show at least the following information:

1. For Work:
    a. All activities commenced in the preceding two (2) weeks (by area and activity number from the approved Project Schedule).
    b. All activities completed in the preceding two (2) weeks (by area and activity number from the approved Project Schedule).
    c. All activities upon which work was performed in the preceding two (2) weeks (by area and new percentage complete conforming to Project schedule information).

2. For Materials: Maintain a database of major items of material to provide weekly update of the buy-out and delivery status showing:
    a. Item Description, listed in accordance with Specifications Section Number in which the item is called for (Note Project Schedule Activity number for all

applicable items).
b. Purchase Order No. and Date of Issue.
c. Vendor Name.
d. Date Shipped and Shipping Means Utilized.
e. Estimated Date of Arrival at Job Site.
f. Actual Date of Arrival at Job Site and Receiving Report Number.

C. Data Processing: Process the data by computer-aided methods to a degree of promptness and accuracy assuring complete display of all pertinent current information at date of each periodic report. Provide a hard disk copy of each Weekly Status Report.

PART 3 - EXECUTION

3.1 PRELIMINARY ANALYSIS

A. Contents:

1. Show all activities of the Contractor under this Work for the period between receipt of Notice to Proceed and Submittal of Construction Schedule required as noted above.

2. Show the Contractor's general approach to remainder of the Work.

3. Show cost of all activities scheduled for performance before submittal and approval of the construction schedule.

B. Submittals shall be in accordance with other Division 1 provisions.

3.2 CONSTRUCTION SCHEDULE

A. As soon as practicable after Contract award, and not later than fifteen (15) calendar days after the issuance of the Notice to Proceed, the Contractor must gather scheduling data from all Prime Subcontractors and complete the Construction Analysis described in Article 2.01 above, in preliminary form. The Contractor must then conduct a Scheduling conference attended by all Prime Subcontractors, Architect and the Construction Manager, review contents of proposed construction schedule, and make all revisions agreed upon at the Scheduling Conference. Submit in accordance with Article 1.03 above.

B. All Prime Subcontractors must submit required scheduling data to the Contractor within ten (10) calendar days after Contract award.

3.3 WEEKLY STATUS REPORT

A. Prepare, update and review with Prime Subcontractors and Suppliers weekly in accordance with Articles 1.03 and 2.02 above.

3.4 PERIODIC REPORTS

A. Construction Schedule, Contents:

1. Report actual progress by updating the mathematical analysis.

2. Note on the summary report, or clearly show on a revised issue of affected portions of the detailed diagram, all revisions causing changes in the detailed program.

3. Revise the summary report as necessary for clarity.

4. Show activities or portions of activities completed during the reporting period and their actual value.

5. State the percentage of Work actually completed, the schedule as of the report date, and the progress along the critical path in terms of days ahead of or behind the allowable dates.

6. If the Work is behind schedule, also report progress along other paths with negative float.

7. Include a narrative report which shows, but is not necessarily limited to:
   a. A description of the problem areas, current and anticipated;
   b. Delaying factors and their impact;
   c. An explanation of corrective actions taken or proposed.

8. Show the date of latest revision. Submit in accordance with the provisions above.

B. Weekly Status Reports

1. On the letter of transmittal accompanying periodic reports, on an accompanying summary sheet, or by other means acceptable to the Construction Manager and Architect, clearly indicate those items of construction which, or materials the delivery of which are critically overdue or otherwise hazardous to maintenance of the approved schedule.

2. Submit in accordance with the provisions above.

C. Revisions: Make only those revisions to the approved Construction Schedule as are approved by the Architect/Owner.

END OF SECTION 01325

SECTION 01380 - CPM SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall prepare and submit a construction schedule based upon input from the Prime Subcontractors as set forth in Section 00800.

B. The schedule shall include line items for the following information broken down by trade:

1. Contractual milestone dates as set forth in Section 01800.
2. Critical and long-lead item delivery dates
3. Owner activities including move-in/occupancy time
4. Critical inspections or testing
5. Other critical activities appropriate to project
6. Separate activity lines for new additions and renovation areas
7 Punch list and final completion period

C. The Construction Schedule shall be completed within thirty (30) days of the Notice to Proceed. The Contractor shall distribute copies to the Owner, Architect, Construction Manager and Prime Subcontractors. The Contractor shall provide a sign-off block for signature by all Subcontractors indicating their acceptance of the schedule. All Subcontractors shall sign off on the schedule at the job meeting closest to the date of distribution. Failure to submit a monthly schedule update will be grounds for the withholding of payments.

D. Schedule updates shall be provided at least monthly but more often if requested by the Owner or Architect. The monthly update shall be distributed by the Contractor to all Subcontractors for purposes of providing input. Each monthly update shall include a progress bar for each activity. The monthly update shall be submitted to the Architect, Construction Manager and Owner each month prior to the requisition cut-off date. Failure to submit a monthly schedule update will be grounds for the withholding of payments.

E. The project will be scheduled and monitored using a construction schedule; Critical Path method (CPM) techniques. The Contractor will prepare all schedules and all periodic updates based upon information furnished by the Prime Subcontractors and observations of the work in progress. Revisions of the schedule to reflect changes in the Contractors' plan of performance or modifications of the Bid Documents will be prepared by the Contractor.

F. This section describes the CPM Progress Schedule requirements. Each Prime Subcontractor shall provide all necessary information in connection with their Work to enable the Contractor to comply with these requirements. Further, each Prime Subcontractor shall provide such information in a timely manner to permit the Contractor to comply with the time requirements stated herein.

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G. Monthly update conferences will be held with all concerned. At these update conferences, the attendees will review actual progress, planned progress, planned progress for the next period, change orders, job issues, and any schedule changes since the previous update. Attendance in mandatory. Contractor current estimate payments are contingent upon attendance and the provision of satisfactory CPM base schedule and update information. The monthly update conference may be scheduled more frequently when required, at the direction of the Contractor.

H. The Contractor shall prepare, based upon information obtained from the Subcontractors, and maintain a detailed Progress Schedule as described below. The schedule shall reflect the Contractor's working schedule and be used to plan, organize and execute the Work, record and report actual performance and progress, and show how the Contractor plans to complete all remaining Work. The schedule shall be in the form of an activity oriented network diagram (Critical Path Method) I-J format. The principles and definition of the terms used herein shall be as set forth in the Associated General Contractors of America (AGC) publication "The Use of CPM in Construction", Copyright 1976. In the event of discrepancies, this section shall govern the development and utilization of the Progress Schedule.

I. The completed schedule shall be distributed to all Prime Subcontractors. When the schedule is approved by each Prime Subcontractor, the Owner, Architect, Construction Manager or their agents will review the schedule for conformance with the Contract requirements, and it shall become one of the Bid Documents.

1. This schedule may be revised to show changes in the Contractors' method of their agreement that the Progress Schedule represents their intentions and interpretations of the requirements of the Contract.

1.2 PRE-BID SCHEDULE

A. The Pre-bid Schedule outlined in Section 01800 indicates a general sequence of activities leading towards the completion of the Contract work within the milestones noted.

B. The sequence of operations and the time estimated for activities on the Pre-bid Schedule are shown for information only and are not to be considered binding. Means, Methods, and Procedures are at the discretion of each Prime Subcontractor. Specific interfaces between Subcontractors will be planned in the Progress Schedule process described below. However, the Contract completion date and any milestone dates for substantial completion are binding. The actual date when written Notice to Proceed is issued will be used in the CPM Logic Diagrams to calculate the milestone dates for those dates contingent on the Notice to Proceed date and will be used to prepare the Official Construction Schedule, using the Subcontractor's proposed sequence of Work and duration of activities.

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1.3 PRELIMINARY SCHEDULE

A. Within (10) working days of Notice to Proceed (NTP), all Prime Subcontractors shall participate in an initial scheduling conference. Attendance is mandatory for all Subcontractors. Each Subcontractor will submit as a minimum, a detailed ninety (90) day Work plan in arrow/activity format for approval together with a generalized project schedule network, in summary form, meeting the contractual milestone dates. During this meeting the schedule will be developed from input furnished by each Prime Subcontractor. Until the formal schedule has been developed and is approved by the Architect and Construction Manager, the ninety (90) day Work plan will serve as the official construction schedule after the review and coordination with each Prime Subcontractor.

B. Where such coordinated Work is required, (Single Overall Contract), the Contractor shall schedule reasonable durations and provide proper advance notice for the Work of the Prime Subcontractors to the extent that normal time Work is accommodated without the need for overtime or shift Work.

C. The Contractor shall develop a 90-day Schedule within ten (10) working days after the initial scheduling conference, utilizing input from Prime Subcontractors. This schedule will be in arrow network form, with each node calendar date based on "early start, early finish" of each Work activity. The 90-day Schedule will contain Work activities over the first ninety (90) days, estimated duration for each Work activity will be fifteen (15) Work days or will show the key procurement items which will occur during the first ninety (90) days of the project in addition to the field Work.

1.4 DETAILED SCHEDULE

A. Within thirty (30) calendar days of Notice to Proceed (NTP), all Prime Subcontractors shall participate in a detailed scheduling conference. Attendance is mandatory. Each Prime Subcontractor shall submit network based coordinated CPM Schedule information to the Contractor for review. Each Subcontractor shall Work with the Contractor to prepare the CPM network in a sketch format and, unless otherwise approved by the Owner's Representative, shall meet each consecutive day for eight (8) hours minimum until a useable, logical CPM schedule network, responsive to the project requirements, has been developed as determined by the Owner's Representative. Non-critical path activities shall be scheduled to reflect the float status shown on the Preliminary Construction Schedule unless otherwise approved by the Construction Manager and the Architect.

B. Where coordinated Work is required, the Contractor shall schedule reasonable durations and proper advance notice for the Work of the Prime Subcontractors to the extent that normal time Work is accommodated without the need for overtime or shift Work.

C. Based upon CPM Schedule information submitted, the Contractor will draft and computerize the schedule and issue it for review an comment. In the event the

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milestone dates indicated by the Progress Scheduled exceed the contractual dated, each Subcontractor shall review and revise the logic and time estimates and resubmit to the Contractor for review within one (1) week of notification. This procedure shall be followed for all schedule revisions. After changes in the logic and/or time estimated have been agreed upon, another computerized schedule will be generated and referred to the Contractor.

D. The Detailed Network Diagram shall provide sufficient detail and clarity of form and technique so that the Contractor can plan, schedule and control their Work properly and the Construction Manager can readily monitor and follow the progress for all portions of Work. The Detailed Network Diagram shall comply with the various limits imposed by the Scope of Work and by any contractually specified intermediate milestone dates and completion dates included in the Contract. The degree of detail shall be to the satisfaction of the Construction Manager, but the following factors shall have a bearing on the required depth of activity detail:

1. The structural breakdown of the project.
2. The type of Work to be performed and the labor trades involved.
3. All purchase, manufacture and delivery activities for all manor materials and equipment.
4. Deliveries of Owner furnished equipment.
5. Submittal and approval of shop drawings and material samples.
6. Plans for all key Trades and Subcontract Work.
7. Assignment or responsibility for performing all activities.
8. Access and availability to Work areas.
9. Identification of interfaces and dependencies with preceding, concurrent and follow-on Subcontractors.
10. Testing of systems.
11. Planning for phased or total takeover by Owner.

E. The Progress Schedule will not include every item of Work necessary to complete the project. However, each Subcontractor shall accept responsibility to schedule and complete all items of Work within the contractual limits.

F. The durations as outlined in the Progress Schedule shall be analyzed in detail to determine activity time durations in units of whole working days. Activities shown will have maximum duration of twenty (20) working days, except in the case of the non-construction activities such as procurement of materials and delivery of equipment. All durations shall be the result of definitive manpower and resource planning by the Prime Subcontractors.

1.5 AUTOMATED DATA PROCESSING (ADP)

A. The mathematical analysis of the Detailed Network Diagram shall be made by computer and a tabulation for each activity shall include as a minimum, the following:

1. Preceding and following event numbers.

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2. Activity description.
3. Durations in Work days for each activity.
4. Earliest start date (by calendar date).
5. Earliest finish date (by calendar date).
6. Latest start date (by calendar date).
7. Latest finish date (by calendar date).

1.6 SUMMARY SCHEDULE

A. The Contractor shall also prepare and submit on the Initial and all updated schedules, a time-scaled Summary Schedule on a single sheet showing the total project in approximately fifty to one hundred (50) - (100) activities. This schedule will accurately summarize the Detailed Schedule. Each activity will indicate and I and J note that corresponds to the Detailed Schedule. The Summary Schedule shall be updated monthly showing the original as-planned schedule denoted and the current update information denoted.

1.7 COMPLETION REQUIREMENT

A. The Preliminary Schedule will be completed within thirty (30) calendar days of the Notice to Proceed.

B. The Progress Schedule (logic diagrams and computer computations) and the Summary Schedule shall be prepared for review within sixty (60) calendar days after Notice to Proceed. The Prime Subcontractor(s) shall review the schedule and note any corrections required as a condition of approval within ten (10) days of the receipt of the schedule. The Contractor will prepare a final Progress Schedule for approval of the Prime Subcontractors within twelve (12) calendar days following receipt of the Prime Subcontractor's comments.

C. When the Progress Schedule is completed and is within contractual limits, each Prime Subcontractor shall certify in writing on the face of the computer printout and submit it to the Architect and Construction Manger for approval no later than seventy-five (75) calendar days after Notice to Proceed, unless otherwise approved by the Architect and Construction Manager.

D. The Contractor will furnish the Prime Subcontractors two (2) copies of Computer Printouts (computations).

E. If the Contractor fails to submit the required monthly update material as indicated in this section within ten (10) calendar days, or revisions thereof within the requested time, the Architect may withhold approval of progress payment estimates until such time as the Contractor submits the required information.

F. Notwithstanding the implementation of the CPM, it shall be the sole responsibility of the Prime Subcontractors to complete the Work within the time of completion and milestone required by the Contract.

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1.8 UPDATINGS

A. The first update shall take place thirty (30) calendar days after the Notice to Proceed with subsequent updates performed monthly at the job site for the duration of the Contract.

B. The Preliminary Schedule will be updated until the Progress Schedule is reviewed and approved by the Subcontractors.

C. All update information contained on the 90-day Schedule will be incorporated into the Progress Schedule once the Progress Schedule is accepted.

D. Each Prime Subcontractor is required to attend and participate in update meetings with the Contractor and present data prepared in advance, updated as of the end of the updating period, a complete and accurate report of updated procurement items, and construction progress. Each Prime Subcontractor shall show how it will make up the time list due to non-excused Contractor delays. The following will also be presented and made part of the CPM update:

1. Actual start dates.
2. Actual completion dates.
3. Revised logic and changes in activity durations.

E. Should the projected completion time for any significant Work activity as determined by the latest CPM printout of the Progress Schedule indicate more than a critical ten (10) day delay to the project, the Subcontractor shall submit a revised plan to the Contractor, within five (5) calendar days, to recover all lost time and maintain the project schedule. This revised plan is to include a re-sequencing of Work activities and/or revisions to the performance time for the affected activities so that remaining milestone completion dates are met.

F. Each Prime Subcontractor shall be responsible to coordinate its Work with the Work of other Prime Subcontractors. Each Prime Subcontractor shall not delay and/or interfere with the Work of others. Each Prime Subcontractor shall pay all costs for damages and/or delays to other Subcontractors caused by lack of coordination and/or interference with their Work which could not be reasonably avoided.

1.9 CHANGE ORDERS, DELAYS AND EXTENSIONS OF TIME

A. Extensions of time will only be considered for justifiable delays that are on the critical path and impact milestone dates by exceeding the amount of positive float shown on the approved CPM Schedule. A justifiable delay is delay due to a cause that the Architect / Construction Manager, in their discretion, determines is unforeseeable, beyond the Subcontractor's control, and not due to any fault, negligence, act, or omission on the part of the Subcontractor. Positive float is the number of calendar days an activity can be delayed without causing a delay to the critical path or

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milestone completion dates. The Contractor shall plan construction activities to start on "early start dates" to maintain positive float and shall be responsible for any delays which could have been avoided by starting Work on the "early start dates" by lack of continuous effort, and/or by inadequate planning, and coordination of the Work. Such delays will not be the basis of an extension of time to any milestone date or additional costs.

B. When change orders or delays are experienced, the Contractor shall submit to the Architect / Construction Manager, a written Time Impact Analysis illustrating the influence of each change or delay on the current Progress Schedule completion date. Each Time Impact Analysis shall include a network analysis demonstrating how the Contractor proposed to incorporate the change order or delay into the Progress Schedule. Additionally, the analysis shall demonstrate the time impact based on the date the change is given to the Contractor, the status of construction at that point in time, and the event time computation of all effected activities. The event times used in the analysis shall be those included in the latest updated copy of the Progress Schedule, closest to the time of delay or as adjusted by mutual agreement. Each time Impact Analysis shall be submitted within seven (7) calendar days after a delay occurs or notice of direction for a change is given to the Contractor. In cases where the Contractor does not submit a time Impact Analysis for a specific change order of delay within the specified period of time, then it is mutually agreed that the particular change order or delay has no time impact on the Contract completion date and no time extension is required. Approval or rejection of each Time Impact Analysis by the Construction Manager and the Architect shall be made within fourteen (14) calendar days after receipt of each Time Impact Analysis unless subsequent meetings and negotiations are necessary.

END OF SECTION 01380

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SECTION 01400 - MATERIAL TESTING / QUALITY CONTROL SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for material testing and quality control services.

1. **Testing and inspecting services other than the Special Inspections - Material Testing (if any) are required to verify compliance with requirements specified or indicated and are the responsibility of the Contractor. These services do not relieve Contractor of responsibility for compliance with the Bid Document requirements.**

B. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

1. Quality Control Services is the responsibility of the Contractor.

2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Bid Document requirements.

3. Requirements for Contractor to provide quality-control services required by Architect, and the Owner or Authorities Having Jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections in AIA Document A232 and Section 01200.

2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.

3. Division 2 through 16 Sections for specific test and inspection requirements.

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1.3 DEFINITIONS

A. Quality Control Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples.

1. Mockups establish the standard by which the Work will be judged.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Bid 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.

1.5 REGULATORY REQUIREMENTS

A. Copies of Regulations: Obtain copies of referenced regulations which also available in Local Public Libraries.

1.6 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: When requirement is indicated in specific technical section and/or when requested by the Architect, in addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed

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by the responsible design professional, for each product and system specifically assigned to 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.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for preforming tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Bid Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

A. 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.

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B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. 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.

E. Professional Engineer Qualifications: A professional Engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

2. Contractor responsibilities include the following:
    a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
    b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.

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d. When testing is complete, remove assemblies; do not reuse materials on Project.

3. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and the Owner with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Bid Documents.

H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.

2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed, unless otherwise indicated.

1.8 QUALITY CONTROL

A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by Authorities Having Jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Bid Documents are Contractor's responsibility.

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a. Submit additional copies of each written report directly to Authorities Having Jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Bid Documents.

1. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   a. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   b. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   c. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   d. Do not release, revoke, alter, or increase requirements of the Bid Documents or approve or accept any portion of the Work.
   e. Do not perform any duties of Contractor.

2. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   a. Access to the Work.
   b. Incidental labor and facilities necessary to facilitate tests and inspections.
   c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   d. Facilities for storage and field-curing of test samples.
   e. Delivery of samples to testing agencies.
   f. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   g. Security and protection for samples and for testing and inspecting equipment at Project site.

3. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   a. Schedule times for tests, inspections, obtaining samples, and similar activities.

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4. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Bid Documents. Submit schedule within 30 days of date established for commencement of the Work.
    a. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

2. Comply with the Bid Document requirements for Division 1 Section "Cutting and Patching."

3. Protect construction exposed by or for quality-control service activities.

4. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

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SECTION 01410 - REFERENCES AND INDUSTRY STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The work of this Section applies to all Construction Bid Documents including Drawings, Division 1 - Miscellaneous Requirements Sections, and Specifications Sections included in Part-2 through Part-6.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used to convey Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings or to other paragraphs or schedules in Specifications and similar requirements in the Bid Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by Authorities Having Jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

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J. The term "experienced," when used with an entity, means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of Authorities Having Jurisdiction, subject to verification by and approval of the Architect.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. "Project site(s)" is the 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.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Bid Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Bid Documents to the extent referenced. Such standards are made a part of the Bid Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Bid Documents, unless otherwise indicated.

C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be 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.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Bid Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

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E. Abbreviations and Acronyms for Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Bid Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S.".

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01455 - CONCRETE IN-SITU RELATIVE HUMIDITY AND pH TESTING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. The General Construction Work Contractor shall engage and pay for a testing agency to provide in-situ concrete relative humidity and surface pH testing to existing concrete surfaces specified to be covered with floor coverings or resinous coatings. Testing Agency shall be approved by the Architect / Owner.

B. Testing to be scheduled no less than 1 nor more than 3 weeks prior to scheduled flooring installation.

1.2 RELATED SECTIONS:

A. Section 09650 - Resilient Flooring

B. Section 09652 - Sheet Vinyl Floor Coverings

C. Section 09685 - Carpet Tile

1.3 REFERENCES

A. ASTM F-2170-11– Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes

B. ASTM F-710-11 – Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

C. ASTM F-1869-11 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

1.4 SUBMITTALS

A. Report all test results in chart form listing test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.

B. List test locations on floor plans and show same on 8-1/2 x 11 Table and Location maps. Deliver results in duplicate for distribution to Architect, Construction Manager and General Contractor.

1.5 QUALITY ASSURANCE

A. Independent Testing Agency

1. Certified by Test Apparatus Manufacturer for product use.

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2. I.C.R.I. (International Concrete Repair Institute) certified, or other agency with verifiable experience.

B. Flooring Installers

1. Certified and /or approved by Test Apparatus Manufacturer for product use.

C. Digital “Reader” and calibrated relative humidity sensors.

1. Factory-calibrated “Smart Sensors” using Touch-n-Sense™ technology.

2. NIST-traceable factory calibration

D. Wide range pH paper, and distilled or de-ionized water.

PART 2 - PRODUCTS

2.1 MANUFACTURES

A. Rapid RH® relative humidity and temperature sensor kit as manufactured by Wagner Meters; or approved equal.

B. pH test paper as manufactured by Micro Essential Laboratory; or approved equal.

PART 3 - EXECUTION

3.1 QUANTIFICATION OF RELATIVE HUMIDITY AT 40% OF CONCRETE THICKNESS

A. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criteria is not possible, then minimum conditions should be 75± 10°F and 50± 10% relative humidity. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.

B. The number of in-situ relative humidity test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 in the first 1,000 sq. ft. and 1 per each additional 1,000 square feet.

C. Determine the thickness of the existing concrete slab, typically from Bid Documents.

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D. Utilizing a roto-hammer drill test holes to a depth equal to 40% of the concrete thickness*. (i.e.: 2″ deep for a 5″ thick slab, or 1½″ deep for a 4″ thick slab). Hole diameter shall not exceed outside diameter of the probe by more than 0.04″. Drilling operation must be dry.

E. Vacuum and brush all concrete dust from test hole.

F. Insert a relative humidity probe (sensor) to the full depth of test hole. Place cap over probe.

G. Permit the test site to acclimate, or equilibrate, for 1 to 2 hours prior to taking relative humidity readings.

H. Remove the cap, insert the cylindrical reading device, and press button on the device to obtain reading from the in-situ probe.

I. Read and record temperature and relative humidity at the test site.

* Elevated structural slab (not poured in pans) should be tested at a depth equal to 20% of its thickness.

3.2 QUANTIFYING pH LEVEL

A. At or near the relative humidity test site perform pH test.

1. Place several drops of water onto the concrete surface to form a puddle approximately 1″ in diameter.

2. Allow the water to set for approximately 60 seconds.

3. Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading

B. Record and report results to the Architect, Construction Manager and the General Contractor.

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SECTION 01505 - TEMPORARY FACILITIES

1.1 RESPONSIBILITIES OF CONTRACTOR

A. Contractor is responsible for the following temporary facilities and services:

1. Installation, operation, maintenance and removal of each temporary facility usually considered as its own normal construction activity.

2. Plug in electric cords, extensions cords, supplementary plug in task lighting and special lighting necessary exclusively for their own activities.

3. Their own storage and fabrication sheds.

4. All hoisting requirements for their Work.

5. Collection and disposal of debris, hazardous, unsanitary or other harmful waste material from their operations, on a daily basis to trash receptacles, hoppers, containers, dumpsters, etc. furnished by the Contractor.
   a. **Refer to Section 01050 - Alterations, Cutting, Patching and Refinishing Work which identifies the responsible Contractor for the collection and disposal of debris and Section 01524 - Construction Waste Management for additional information.**

6. Six foot (6'-0") high site enclosure fence, including maintenance and any gates needed. Provide fence relocations as needed during construction.

7. The secure lockup of their own tools, materials and equipment.

8. Construction aids and miscellaneous services and facilities necessary exclusively for their own construction activities.

9. Temporary storage provisions for Work, including offsite provisions, if required.

10. Containerized bottled drinking water units for their personnel.

11. Fire protection provisions related to work including fire extinguishers.

12. All personnel safety equipment and provisions for their personnel.

13. Environmental protections.

14. Dust and fume control

15. Tree and plant protection.

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16. Other temporary facilities and services stated as their responsibility elsewhere in the Bid Documents.

17. Temporary toilets in sufficient quantity to suit project needs and including disposable supplies.

1.2 COMPRESSED AIR

A. Contractor shall furnish their own equipment and energy source to provide compressed air required for the completion of Work under the Contract.

1.3 REMOVAL AND RESTORATION OF TEMPORARY FACILITIES

A. At the completion of the Work prior to final payment, Contractor shall remove temporary facilities and Work which they has been responsible. Refer to Section 01700 for additional requirements.

1.4 UTILITY CONSUMPTION

A. The Owner shall be responsible and pay all utility costs for electric and water consumption during the construction period.

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SECTION 01524 - CONSTRUCTION WASTE MANAGEMENT

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 administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.

2. Recycling nonhazardous demolition and construction waste.

3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. All of Division 1 and attached Specifications and Drawings that make a part of this Contract.

1.3 DEFINITIONS

A. Construction Waste: Building improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to Authorities Having Jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.4 SUBMITTALS

A. Waste Management Plan: Submit 4 copies of plan within 30 days of date established for the Notice to Proceed.

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B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Qualification Data: For refrigerant recovery technician.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of Authorities Having Jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan.

2. Review requirements for documenting quantities of each type of waste and its disposition.

3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.

4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

5. Review waste management requirements for each trade.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, and waste reduction Work

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plan. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Owner / Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 1 Section "Temporary Facilities" for operation, termination, and removal requirements.

B. Training: Train workers, Subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

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1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Sale and Donation: Not permitted on the Project site.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiving or processor.

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3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

3.5 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to Authorities Having Jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials on-site.

C. Burying: Do not bury waste materials on-site.

D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

E. Washing waste materials into sewers or drains is not permitted.

END OF SECTION 01524

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SECTION 01600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The work of this Section applies to all Construction Bid Documents including Drawings, Division 1 - Miscellaneous Requirements Sections, and Specifications sections included in Part-2 through Part-6.

1.2 SUMMARY

A. Section Includes:

1. General product requirements, including:
   a. General specification requirements for all products.
   b. General requirements and procedures for maintenance materials and tools.

2. General requirements for product documentation, including:
   a. Requirements and procedures for schedule of products.
   b. General requirements for operation and maintenance data.

3. General procedures for products including:
   a. Procedures for transportation and handling.
   b. Procedures for delivery and receiving.
   c. Procedures for storage.

PART 2 - PRODUCTS

2.1 GENERAL

A. Components required to be supplied in quantity within a Specification section shall be identical, interchangeable and made by the same manufacturer.

B. Do not use products removed from existing construction.

2.2 MAINTENANCE MATERIALS AND TOOLS

A. Maintenance Materials: Parts and materials for repair and maintenance; specific items required are specified in product sections.

1. Provide products and tools which are identical to those used in the Work; if necessary to obtain identical items, order at the same time as products to be installed or tools to be used in the Work.

B. Package appropriately and label to show type and quantity of contents.

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C. Deliver, handle, and store in the same manner as products to be installed.

D. Do not turn over to the Owner until date of substantial completion, unless otherwise approved by the Owner.

E. Deliver to the Owner; unload.

F. Obtain receipt prior to final payment.

PART 3 - EXECUTION

3.1 PRODUCTS

A. It is the Contractor's responsibility to select products which comply with the Bid Documents and which are compatible with one another, with existing Work, and with products selected by other (Sub)Contractors.

1. Verify that electrical characteristics of products are compatible with electrical systems; notify Architect of all discrepancies.

2. Where visual matching to an established physical sample is required, the Architect's decision will be final.

B. Do not use any substitute products which have not been approved in accordance with the requirements of the Bid Documents.

C. Where the Specification is silent on whether substitutions will be considered, substitutions will be considered only when submitted in accordance with AIA A232 and Section 00800.

D. Products Specified by Reference Standard: Use any product meeting the Specification. Provisions of reference standards shall not modify the responsibilities of the Owner or Architect as defined in the Bid Documents.

E. Products Specified by Performance Requirements: Use any product meeting the Specification.

F. Products Specified to Match a Physical Sample: Use any product that matches; obtain the Architect's approval.

G. Products Specified by Listing a Brand Name Product(s) made by listed Manufacturer(s) as the "Basis of Design":

1. Pursuant to N.J.S. 18A:18A-15(d) indicated basis of design brand name product(s) or equivalent made by one of the manufacturers listed will be acceptable and as determined by the Architect.

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H. Products Specified by Listing Brand Name Product(s) Accompanied by Language Indicating that Substitutions Are Allowed: Provide a product meeting the Specification; submit substitution request for any brand-name product, that is not listed, in accordance with section 00800.

I. Products Specified by Listing Manufacturer(s): Provide a product meeting the Specification and made by one of the manufacturers listed or an approved equal. Approval of substitutions will be in accordance with AIA A232 and Section 00800.

3.2 SCHEDULE OF PRODUCTS

A. Prepare a complete schedule of products used, including the following for each product:

1. Manufacturer's name.

2. Brand or trade name.

3. Model number, if applicable.

4. Reference standard, if more than one is applicable.

5. Arrange products in the schedule by Specification sections; indicate paragraph where specified.

B. Prepare and submit a preliminary schedule within 15 working days after award of Contract; resubmit when revised; submit final schedule prior to final payment. See additional requirements and milestone dates in section 01800.

C. Schedule of products shall not be used to obtain approval of substitute products; make separate request for substitution.

3.3 OPERATION AND MAINTENANCE DATA

A. Provide operation and maintenance data as specified in individual product sections.

1. Provide data sufficient for operation and maintenance by Owner without further assistance from the manufacturer.

2. Provide completed data in time for use during Owner instruction.

B. Data Required For Products - General:

1. Name of manufacturer and product.

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2. Name, address, and telephone number of subcontractor or supplier.

3. Local source of replacements.

4. Local source of replaceable parts and supplies.

C. Product Data: Where product data is specified for inclusion in operation and maintenance data, provide manufacturer's data sheets marked to indicate specific product and product options actually installed; delete inapplicable data.

D. Project Record Documents: Provide an additional copy of applicable record documents for inclusion with the operation and maintenance data.

E. Coordination Drawings: When coordination drawings are prepared, include a copy with the operating and maintenance data.

F. Custom Manufactured Products (if used with prior approval): Provide all information needed for reordering.

G. Finish Materials: Manufacturer's product data, color/texture designations, and manufacturer's instructions for care, cleaning, and maintenance.

H. Equipment: Provide at least the following information:

1. Product data giving equipment and function description, with normal operating characteristics and limiting conditions.

2. Starting, operating, and troubleshooting procedures.

3. Cleaning and maintenance requirements and procedures.

4. External finish maintenance requirements.

5. List of maintenance materials required.

6. List of special tools required.

7. Parts list: List all replaceable parts, with ordering data.

8. Recommended quantity of spare parts to be maintained in storage.

I. Systems: Provide overall function description, with diagrams, prepared especially for this project.

J. Form of Data: Prepare data in the form of an instructional manual.

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1. Arrange contents logically, using section numbers and sequence of sections indicated on the Table of Contents of this project manual.

2. When multiple volumes are used, arrange by related subjects; identify contents in cover title.

3. Assemble into 3-ring binders with maximum 2-inch ring size.
   a. Hardback, cleanable plastic covers.
   b. Identify each book with title "Operation and Maintenance Instructions" and project name.
   c. Page size 8-1/2 by 11 inches, maximum.
   d. Prepare special typewritten data on minimum 20-pound paper.
   e. Provide tabbed divider for each product and system.
   f. Drawings: Bind in with other data; provide reinforced binding edge; fold larger Drawings to size of pages.
      1) Do not use pockets or loose Drawings.

4. Provide Table of Contents for each volume listing:
   a. Name of the project.
   b. Name, address, telephone number, and contact name of:
      1) Architect.
      2) Contractor.
   c. Index of products and systems included in volume.

3.4 TRANSPORTATION AND HANDLING

A. Require supplier to package finished products in a manner which will protect from damage during shipping, handling, and storage.

B. Transport products by methods which avoid damage.

C. Deliver in dry, undamaged condition in manufacturer's unopened packaging.

D. Provide equipment and personnel adequate to handle products by methods which prevent damage.

E. Provide additional protection during handling where necessary to prevent damage to products and packaging.

F. Lift large and heavy components at designated lift points only.

3.5 DELIVERY AND RECEIVING

A. Arrange deliveries of products to allow time for inspection prior to installation.

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B. Coordinate delivery to avoid conflict with the Work and to take into account both the conditions at the site and the availability of personnel, handling equipment and storage space.

C. Clearly mark partial deliveries to identify contents, to permit easy accumulation of entire delivery and to facilitate assembly.

D. Promptly inspect shipments and remedy damage, incorrect quantity, incompleteness, improper or illegible labeling, and noncompliance with requirements of Bid Documents and approved submittals.

3.6 STORAGE

A. No indoor storage areas are available on-site.

B. General Storage Procedures:

1. Store products immediately on delivery.

2. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible.

3. Store in a manner to prevent damage to the stored products and to the Work.

4. Store moisture-sensitive products in weathertight enclosures.

5. Store indoors if necessary to keep temperature and humidity within ranges required by manufacturer.

6. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

7. Arrange storage to provide access for inspection and inventory.

8. Periodically inspect and remedy damage and noncompliance with required conditions.

C. Loose Granular Materials: Store on solid surfaces in well-drained area; prevent mixing with foreign materials.

D. Exterior Storage:

1. Cover products subject to weather damage with impervious sheet covering; provide ventilation to avoid condensation.

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2. Provide surface drainage to prevent runoff or ponded water from damaging stored products.

3. Prevent damage and contamination from refuse and chemically injurious materials and liquids.

4. Store fabricated products on substantial platforms, blocking, or skids above the ground, sloped to drain.

END OF SECTION 01600

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SECTION 01700 - PROJECT CLOSEOUT DOCUMENTS AND PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Work of this Section applies to all Construction Bid Documents including Drawings, Specifications, Division 1 - Miscellaneous Requirements Sections, and Specification Sections included in Part-2 through Part-6.

1.2 SUMMARY

A. Section Includes:

1. Maintenance of Project Record Documents,
2. Record drawings, including As-Built drawings,
3. Record project manual (Specifications),
4. Operation and Maintenance Manuals,
5. Warranties,
6. Extra Materials,
7. Submittals required prior to requesting for determining dates of substantial and final completion, and also prior to release of final payment(s),
8. Transmittal of Closeout Project Documents to the Owner,
9. Instructions of Owner's personnel,
10. Final Cleaning.

B. GENERAL REQUIREMENTS

1. All submittals shall indicate reference to the appropriate Architect's Project Number.

C. As-Built Drawings:

1. Full-size paper set.
2. Two (2) USB Drives.

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1.3 MAINTENANCE OF PROJECT RECORD DOCUMENTS

A. Do not use record documents of any type for construction purposes.

B. Maintain record documents in a secure location at the site while providing for access by the Contractor and the Architect during normal working hours; store in a fire-resistive room or container outside of normal working hours.

C. Record information as soon as possible after it is obtained.

D. Assign a person or persons responsible for maintaining record documents.

E. Record the following types of information on all applicable record documents:

1. Dimensional changes.

2. New and revised details.

3. Actual routing of piping and conduit.

4. Revisions to electrical circuits.

5. Actual equipment locations.

6. Sizes and routing of ducts.

7. Locations of utilities concealed in construction.

8. Particulars on concealed products which will not be easy to identify later.

9. Changes made by modifications to the Contract; note identification numbers if applicable.

10. New information which may be useful to the Owner, but which was not shown in either the Bid Documents or submittals.

1.4 RECORD AND AS-BUILT DRAWINGS

A. During the progress of the installation, the Contractor shall keep a careful record of all changes and variations in the arrangement of their Work from the layout shown on the Contract Drawings in order that the Owner may be provided with a complete set of all plans (As-Builts) showing the Work as actually installed.

1. The Contractor shall maintain complete two (2) sets of opaque prints of the Contract Drawings, marked to show changes which occur due to their Work.

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2. Where the actual Work differs from that shown on the Drawings, mark this set to show the actual Work.

3. Mark location of concealed items before they are covered by other Work.

4. Mark either record Contract Drawings or shop drawings, whichever are best suited to show the change.

5. Where changes are marked on record shop drawings, mark cross-reference on the applicable Contract Drawing.

6. When the Contractor is required by a provision of a modification to prepare a new Drawing, rather than to revise existing Drawings, obtain instructions from the Architect as to the Drawing scale and information required.

7. Keep Drawings in labeled, bound sets.
   a. Mark with red pencil.
   b. Mark Work of separate Trades with different colors of pencils.

8. Incorporate new Drawings into existing sets, as they are issued.

9. Where record drawings are also required as part of operation and maintenance data submittals, make copies from the original record drawing set.

10. As-Built Drawing Format to be submitted to the Architect:
    a. One (1) complete, legible full-size paper (hard copy) As-Built drawing set with the following information on each page:
       1) Note: "As-Built" drawing,
       2) Contractor's Firm name,
       3) Date.
    b. Two USB drives containing scanned As-Built drawings (pdf format) of the hard copy furnished to the Owner (indicated above) shall be furnished to the Owner and the Architect and as directed by the Architect.

11. Mechanical/ Electrical As-Built drawings must be submitted to the Engineer with a copy of the transmittal to the Architect. Approval must be obtained before issuing Final Certificate of Payment.

B. Record drawings shall be provided for **all Work** including but not limited to the following:

1. General Construction Work
2. Plumbing and Drainage Work
3. HVACR Work
4. Electrical Work

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1.5 PROJECT SPECIFICATION MANUAL

A. The Contractor shall maintain a complete copy of the project Specification manual, marked to show changes which occur due to their Work.

B. Where the actual Work differs from that shown in the project manual, mark the record copy to show the actual Work.

1. Include a copy of each Addendum and modification to the Contract.

2. In addition to the types of information required on all record documents, record the following types of information:
   a. Product options taken, when the Specification allows more than one.
   b. Product substitutions.
   c. Proprietary name and model number of actual products furnished, for each product, material, and item of equipment specified.
   d. Name of the supplier and installer, for each product for which neither a product data submittal nor a maintenance data submittal was specified.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:
   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown operations.
   d. Description of controls and sequence of operations.
   e. Piping diagrams.

2. Maintenance Data:
   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of Installer or supplier.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.
   h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in

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thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

C. Operation and Maintenance Manuals must be submitted to the appropriate Engineer with a copy of the transmittal to the Architect. Approval must be obtained before issuing Final Certificate of Payment.

1. Contractors shall submit electronic version of the MEP/FP O&M manuals for review by the MEP/FP Consultant. *Paper copies should not be submitted as part of the MEP/FP review process.

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the Table of Contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Warranty manual must be submitted to the Architect for review. Architect's approval must be obtained before issuing final payment.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.8 SUBMITTAL REQUIREMENTS - SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

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1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

2. Advise Owner of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and digital images on USB drive, damage or settlement surveys and similar final record information.

6. Deliver tools, spare parts, extra materials and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Complete startup testing of systems.

9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from the Project site, along with mockups, construction tools, and similar elements.

11. Advise Owner of changeover in heat and other utilities.

12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

13. Complete final cleaning requirements, including touch-up painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.9 SUBMITTAL REQUIREMENTS - FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to the requirements of the Bid Documents.

2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and signed by the Contractor.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment and systems. Provide statement signed by Owner's representatives stating that they have received the required training.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. The cost of additional inspections required by the Architect or their consultants or the Construction Manager due to Contractor's failure to complete the punch list will be paid by the Contractor and will be deducted from the Contractor's final payment.

C. The Contractor is required to obtain all final releases from governmental and regulatory Agencies Having Jurisdiction over the project with the assistance from the Architect / Engineer and Owner, if such final releases from governmental and regulatory Agencies are required on the Project at some point.

1.10 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list to the Architect and Construction Manager. Include name and identification of each space and area affected by construction

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operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, as applicable.

2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect and Construction Manager.
   d. Name of Contractor.
   e. Page number.

1.11 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue - or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, Subcontractor, or similar entity, to prepare the marked-up Record Prints.
   a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
   b. Accurately record information in an understandable Drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
   d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

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5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including Addenda and Contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, Addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Note related Change Orders, Record Drawings and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.12 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors with relevant experience in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times.

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3. Schedule training with Owner, through Architect and Construction Manager, with at least seven calendar days advance notice.

4. Coordinate instructors, including providing notification of dates, times, length of instruction and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

1.13 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Refer to other Division 1 - Specification sections for additional cleaning as required and where applicable.

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 portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective

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surfaces to their original condition.

f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches and similar spaces.

g. Sweep concrete floors broom clean in unoccupied spaces.

h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

j. Remove labels that are not permanent.

k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

(1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Replace parts subject to unusual operating conditions.

n. Plumbing Work Subcontractor shall clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

o. Heating, Ventilating Air Conditioning Work and Refrigeration Subcontractor shall replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

1) Clean ducts, blowers, and coils if units were operated without filters during construction.

p. Electrical Work Subcontractor shall clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent fixtures to comply with requirements for new fixtures.

q. Leave Project clean and ready for occupancy.

r. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

1.14 TRANSMITTAL TO OWNER

A. Collect, organize, label, and package ready for reference.

1. Provide cardboard file boxes for submittals.

2. Provide cardboard drawing tubes with end caps for transparencies.

3. Bind print sets with durable paper covers.

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4. Label each document (and each sheet of Drawings) with "PROJECT RECORD DOCUMENTS - This document has been prepared using information furnished by _____" [insert the Contractor's name], and the date of preparation.

B. Submit to the Architect for transmittal to the Owner, unless otherwise indicated.

1.15 REMOVE TEMPORARY FACILITIES

A. At the completion of the Work prior to final payment, remove all temporary facilities entirely from the site, including, but not limited to, the following:

1. Trailers, temporary toilets, temporary enclosures, dust barriers and other temporary protection devices.

1.16 SUBMITTALS REQUIRED PRIOR TO FINAL PAYMENT

A. Contractor must satisfy all requirements of Sections 01700 and 01900 prior to submitting for Final Payment.

B. A closeout checklist will be provided to the Contractor when they substantially complete. The Contractor is instructed to mark each submittal with the corresponding item number on the checklist. All warranties must have the Owner Name, Project Name, Architect Project Number and Warranty Periods. If all documents are not received in this format, the submittal will be rejected and the Contractor will be instructed to pick these documents up at the Architect's office for correction.

C. Submittals required prior to final payment shall be in accordance with "Checklist" include, but are not limited to, the following items:

1. Completed Operations Insurance Certificate - ACORD Form.

2. Affidavit of Payment of Debts and Claims - AIA Document G706.

3. Affidavit of Release of Liens - AIA Document G706A.

4. Consent of Surety Company to Final Payment - AIA Document G707.

5. Certification of Wages in accordance with New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq.

6. 10% two year Maintenance Bond on the form provided in this Specification.

7. Manufacturers' product warranties, Special written guarantees and warranties, maintenance warranty, etc. in accordance with Section 01900, various Specification sections and the Table of Contents of the Project Manual. This is

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in addition to the two-year guarantee covered by the Maintenance Bond and in addition to the Contractor's two-year guarantee.

a. Guarantee shall be signed and sealed by Officer of the Contracting Firm and shall be notarized.

8. Project Record Drawings, (As-Built Drawings), Record Specifications, Record Product Data, and Miscellaneous Record Submittals.
   a. Note: As-Built Drawings shall be submitted to the appropriate Engineer(s)/ Architect.

9. Operation and Maintenance Manuals and Instructions.
   a. Note: Operation and Maintenance Manuals shall be submitted to the appropriate Engineer(s) / Architect.

10. Balancing Reports for Heating, Ventilating, Air Conditioning and Refrigeration systems.

11. Certificate of Occupancy / Copies of all Building Department inspection approvals.

12. In accordance with requirements of N.J.S.A. 52:32-44. Contractor must submit accurate list of all Subcontractors and suppliers. Contractor must provide a certification that all proofs of business registration for all Subcontractors and suppliers are maintained on their file.

13. All approvals and final releases from governmental and regulatory agencies have jurisdiction including, but not limited to: NJDCA, Local Construction Department, NJDEP, etc., as required.

END OF SECTION 01700

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CLOSEOUT CHECKLIST

Owner		
Title		
Project #		**Contract:**
Contractor		
Substantial Completion Date:		**Updated:**
Refer to Specification Sections 01700 and 01900 for closeout requirements.		
Item No.	**Documents & Warranties Required For Closeout**	**Status**
1	Completed Operations Insurance Certificate - ACORD Form	
2	Completed Operation Insurance Statement (Sample Enclosed)	
3	AIA Document G704 Certificate of Substantial Completion	
4	AIA Document G706 Affidavit of Payment of Debts & Claims	
5	AIA Document G706A Affidavit of Release of Liens	
6	AIA Document G707 Consent of Surety to Final Payment	
7	Certification that all wages have been paid - NJ Prevailing Wage Act, N.J.S.A. 34:11-56.25	
8	10% two-year Maintenance Bond - must be on form provided in spec book - sample attached	
9	Record Project Manual indicating changes or company letter stating no changes.	
10	Two Year Contractor's Guarantee Covered by Maintenance Bond - Sample Attached	
11	Operation Instructions & Maintenance Manuals **(2 each in 3-ring binder)**	
12	Record Drawings. Indicate As-Built drawings with company name, address and date (**1 Paper Set & 2 CD's)**	
13	Final Payment Requisition & Board Voucher/Invoice (3) Contractor will not be closed out until all paperwork is submitted	
14	Certificate of Approval/Acceptance	
15	Confirmation that FVHD has received "hard copies" (not electronic) of all shop drawing submittals.	
16	Copies of all outstanding certified payroll reports or letter on Contractor's letterhead stating all outstanding certified payroll sheet and manning reports have been sent to the Owner.	
17	Letter on Contractor's letterhead stating date of substantial completion and requesting punch list review to Architect & Engineer	
18	Final Punch list signed and dated indicating completion of all work	
19	Submit accurate list of all subcontractors and suppliers and provide a certification that all proofs of business registration for all subcontractors and suppliers are maintained on his/her file.	
20	Balancing & Testing Reports (HVAC)	
21	Fire Alarm Certification (ELECTRICAL)	
22	Warranties - Refer to Specification Section 01900 for required warranties for each trade	

SECTION 01800 - TIME OF COMPLETION AND LIQUIDATED DAMAGES

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes the requirements for completion of interim milestone events and final completion of all work required by the Bid Documents.

B. Related Sections:

1. Items of Work attached to the "Certificate of Substantial Completion" and establishing "Final Completion Time" as per Section 00800.

C. This section also establishes the relation of liquidated damages for failure to complete the interim milestone events or final completion requirements within the time requirements stated herein.

D. **The building (or part of the building) will be occupied at all times. The Contractor shall maintain heat, electric, fire safety systems and emergency egress paths, control dust and water infiltration at all times.**

1.2 TIME FOR COMPLETION

A. It is understood that the / each Contractor has mutual responsibility to complete its Work in sequence with the Work of (Sub)Contractor(s) and to allow the other (Sub)Contractor(s) access to the Work site so that they may complete their Work within the times established.

B. Completion of the Contract Work by the Contractor shall be time of the essence.

C. The Contractor shall Work overtime, additional shifts, weekends or holidays to complete the Work on time with no additional cost to the Owner except as otherwise previously accounted for in the bid submission.

1. Scarce resources will be no excuse for not completing the Work on time.

2. **No Work may take place during the school day in any occupied area. All Work, in occupied areas, shall be performed on second shift (3:00 PM - 11:00 PM) after August 28, 2026 until December 31, 2026 . Only limited / selective Work is permitted. Contractor must review proposed Work activities and have approval of Owner, Construction Manager and Architect prior to proceeding.**

3. **Work may take place during regular shift and second shift (7:00 AM - 10:00 PM) after June 22, 2026 until August 28, 2026; however, the Contractor is required to review and coordinate all Work activities with the Construction Manager, Architect and School Facilities Director prior to commencing with the Work.**

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a. **Contractor to review permitted Work hours to comply with the local "Noise Ordinance".**

4. **Contractor is required to include the cost of any premium time, second shift and weekend Work which may be required in their bid to complete the Work within the indicated milestone dates.**

D. Substantial and final completion of the Work shall include but is not limited to final inspection and acceptance by the Local Building Officials.

1.3 SEQUENCE OF CONSTRUCTION

A. In order to allow the Prime Contractor and Subcontractor(s) to understand the requirements of the Project, the following general sequence of construction Work will be followed:

1. Generally, the General Construction Contractor is to schedule, sequence and coordinate the Work with Subcontractors, as required, to logically progress the Work, meeting the overall design intent, construction quality and time of completion. **Schedule inspections and obtain required approvals of all stages of the Work as required by the Local Construction Officials.**

2. Proper scheduling of the Work includes timely sequencing, preparation, review and approval by the Prime Contractor and **submission of requisite technical and other project submittals and shop drawings** to the Architect / Engineer(s) for approval to advance the proper, logical progression of the Work.

3. After mobilization and securing the Work site, the General Construction Work Contractor is to perform selective demolition of existing general building construction, layout and coordinate the proposed new building construction with existing construction to remain, as noted on the Construction Drawings.
   a. Apply for and obtain demolition permit to allow commencement of the Work while permit applications for new Construction are under review by the Construction Official.

4. Progress the Work of all Trades towards completion, as required, by the Bid Documents to obtain **Substantial Completion** including, inspection and testing by local construction officials, commissioning, testing and balancing of the HVAC, Automatic Temperature Controls, Plumbing and Electrical Work to obtain the Certificate of Occupancy.

5. Provide written formal notification of **Substantial Completion** to the Architect / Engineer and request Punch-List Observations.

6. Complete proper preparation, review and approval by the Prime Contractor and submission of all Close-out Documents, Operation and Maintenance Manuals, As-built surveys and drawings to the Architect / Engineer(s) within Contract time required to achieve **Final Completion**.

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1.5 PROJECT CONTRACT MILESTONE DATES

A. TIME OF COMPLETION

1. **Milestone No. 1**
   a. Sign Contract, no later than **twenty (20)** calendar days, Sundays and Holiday's excepted, from **Notice of Award;** on or about **march 18, 2026.**
   b. Contractor submits Bonds and Insurance **ten (10) calendar days from Notice of Award, Sundays and holidays excepted**.
   c. **Notice to Proceed** shall be within **three (3) business days** of date of signing Contract; on or about **April 15, 2026.**

2. **Milestone No. 2**
   a. **Time Critical submittals** for special equipment, fixtures, etc. shall be submitted within **twenty (20) calendar days from Notice to Proceed.**

3. **Milestone No. 3**
   a. Submission of all remaining technical shop drawing submittals shall be submitted within **thirty (30) calendar days from Notice to Proceed.**

4. **Milestone No. 4**
   a. Physical Work at the site shall commence on or about **June 22, 2026.**

5. **Milestone No. 5**
   a. Substantial Completion of the entire project shall be on or before **261 Calendar Days from the Notice to Proceed, December 31, 2026.**
   b. Liquidated Damages - $2,000.00 / Calendar day of delay.

6. **Milestone No. 6**
   a. Final Completion of all Work including punch list items and closeout documents, no later than **32 Calendar Days from Substantial Completion, February 1, 2027.**
   b. Liquidated Damages - $2,000.00 / Calendar day of delay.

1.6 LIQUIDATED AND OTHER DAMAGES

A. By bidding the Project, the Contractor is accepting that the time allotted for the completion of Work is reasonable. Completion of Work on or about these milestones are prerequisites for the coordinated Work of the Contractor. When the Owner will suffer financial loss and/or extra cost if a milestone task is not completed within the allotted time, the Contractor responsible for the delay in achievement of each milestone, as determined by the Owner's Project Manager and the Architect, shall pay to the Owner a fixed, agreed sum of $2,000.00 as liquidated damages for each calendar day of delay until the milestone task is substantially completed.

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B. The Liquidated Damages set for above shall be in addition to other consequential losses or damages the Owner may incur by reason of such delay, such as, but not limited to, the cost of additional architectural and engineering, independent third party inspection and other services resulting from the delay, additional costs to the Owner for payments to other Contractors resulting from delay.

C. Liquidated Damages are fixed and agreed upon by and between the Contractor and the Owner because of the impracticality and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amounts shall be retained from time to time by the Owner for the current periodical payments.

1. The Liquidated Damages set for above are intended to compensate Owner for loss of use during the period of delay, for other delay during construction which may result further delay in substantial and/or final completion dates and for any acceleration costs by Contractors to recover the defaulting (Sub)Contractor's delay.

2. In no way shall costs of Liquidated Damages be construed as a penalty to the Contractor.

D. The Owner shall have the right to deduct the total amount any Liquidated Damages for which the Contractor may be liable from any monies otherwise due the Contractor, including any retainage under control of the Owner.

E. The Surety providing the Performance Bond, furnished by the Contractor, will be liable for Liquidated Damages assessed against the Contractor, to the extent that the Contractor shall not make settlement thereof with the Owner.

F. The Contractor agrees that in the event the Owner is required to incur or advance any additional necessary and reasonable costs (including but not limited to Architect, Attorney or other fees related expenses), as a result of the failure of the Contractor to perform any obligation of this Contract or to perform its obligations in a timely manner as required by the Bid Documents, the Contractor agrees that such additional necessary and reasonable costs shall be borne by the Contractor and may be deducted by the Owner from any payment due the Contractor.

G. In accordance with N.J.S.A. 18A:18A-19, the Owner shall deduct from the Contract Price, for any wages paid by the Owner to any inspector or inspectors necessarily employed by for the Work of this project, for any number of days in excess of the number of days or indicated dates allowed in milestones above. Such sums shall be part of the Liquidated Damages indicated herein after.

END OF SECTION 01800

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SECTION 01900 - GUARANTEES AND WARRANTIES

PART 1 - GENERAL

1.1 CONTRACT

A. Period for all guarantees and warranties shall commence at date of substantial completion for the entire project, as determined by the Architect.

B. The Contractor's guarantee on all work, covered by Maintenance Bond ..... **Two (2) Yrs.**

1. The Maintenance Bond shall represent a continuing obligation of the Prime Contractor and their Subcontractor(s) to repair/replace defective materials and/or labor of products installed in the project for **two (2) years** from the date of Substantial Completion.

C. Provide all required warranties indicated in Specification sections which include but not limited to the following:

1.2 GENERAL CONSTRUCTION WORK

A. Cement Based Self-Leveling Underlayment as specified in Section 03452. (Pour)

1. Special Project Warranty: Submit a written warranty signed by the manufacturer, the contractor, and the installer, guaranteeing to correct failures in materials and workmanship which occur within the warranty period, including those attributable to abnormal aging, without reducing or otherwise limiting any other rights to correction which the Owner may have under the contract documents.
   a. The warranty shall include responsibility for removing and replacing other work as necessary to accomplish repairs or replacement of materials covered by the warranty.
      1) Special Warranty period: **Two (2) years** after date of substantial completion.

B. Solid Polymer Fabrications as specified in Section 06650.

1. Provide manufacturer's warranty against defects in materials, fabrication and installation, excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for replacement or repair of material and labor for a period of **ten (10) years**, beginning at Date of Substantial Completion.
   a. For fabrications with installed warranty coverage, identify by affixing manufacturer's fabrication/installation source plate.

C. Joint Sealer Assemblies as specified in Section 07900.

1. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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a. Warranty Period: **Five (5) years** from date of Substantial Completion.

2. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   a. Warranty Period: **Five (5) years** from date of Substantial Completion.
   b. Submit two (2) copies of written guarantee for all sealant work of this section signed by the Contractor and the sealant manufacturer for a period of **five (5) years** from the date of acceptance by the Owner.
   c. Guarantee shall further state that all exterior sealant will be guaranteed against:
      1) Adhesive or cohesive failure in joints where movement is under maximum 25% extension or compression.
      2) Any crazing greater than 3 mils in depth developing on surface of material.

D. Wood Doors as specified in Section 08211.....**Life of Installation**.

1. Submit written agreement in door manufacturer's standard form signed by the manufacturer and contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show photographing of construction below its face veneers, or do not conform to tolerance limitations of NWMA.

2. The warranty shall also include refinishing and reinstallation as may be required due to repair or replacement of defective doors.

E. Finish Hardware as specified in Section 08700.

1. Guarantee workmanship and material provided against defective manufacture. Repair or replace defective workmanship and material appearing within period of **two (2) years** after substantial completion.
2. Provide **five (5) year** minimum factory warranty on manual surface door closers against defects in material and workmanship from date of occupancy of project.

3. Provide **five (5) year** minimum factory warranty on exit devices against defects in material and workmanship from date of occupancy of project.

4. Provide **three (3) year** minimum factory warranty on locksets and cylinders against defects in material and workmanship from date of occupancy of project.

F. Glass and Glazing as specified in Section 08800.

1. Manufacturer’s Limited Warranty on Fire-Rated / Impact Glazing: Written warranty, made out to the Owner and signed by manufacturer, warrants only that the product will be free of manufacturing defects resulting in material obstruction through the glass area and/or edge separation and changes in properties of the interlayer for a period of **five (5) years** from the date of purchase, provided the Products have been properly shipped, stored, handled, installed and maintained.

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a. Limitation of Remedy - Inspection: The remedy for product proved to be defective under the terms of this warranty is limited to shipment of replacement product. With respect to all claims under this warranty, the Manufacturer shall have the right to inspect any and all products alleged to be defective.

G. Acoustical Ceilings and Suspension System as specified in Section 09510.

1. Special Manufacturer's Warranty: Written warranty, signed by the ceiling manufacturer agreeing to furnish ceiling materials and replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

2. Warranty Period: **Thirty (30) year** System Performance Guarantee against visible sag, Mold/Mildew and Bacteria Growth.

3. Decorative Ceiling Systems:
   a. Provide manufacturer's special project warranty against defects in workmanship, discoloration, or other defects considered undesirable by Architect / Owner for a minimum period of two (2) years from date of initial acceptance.

H. Resilient Flooring as specified in Section 09650.

1. Luxury Vinyl Tile Flooring (LVT)
   a. Warranty: Manufacturer's standard for material and labor:
      1) A **fifteen (15) year Limited Commercial Warranty** for labor and material. Warranty period shall start from approved date of substantial completion.

2. Wall Base: **Five (5) year** Limited Commercial warranty.

I. Commercial Smooth Sheet Vinyl as specified in Section 09657.

1. Warranty period for Altro Operetta; or approved equal, shall be **ten (10) years** commencing on date of substantial completion

J. Resinous Flooring (Alternate Bid) as specified in 09700.

1. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of **two (2) years** from date of installation or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of **two (2) years** from date of installation.

K. Hygenic Wall Coverings as specified in Section 09720.

1. Warranty: **Twenty (20) years** from date of substantial completion.

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L. High Impact Corner Guards as specified in Section 09940.

1. Standard IPC **Limited Lifetime** Warranty against material and manufacturing defects.

M. Refer to conditions of the Contract for project warranty provisions.

N. Dry Marker Boards / Exhibition Boards as specified in Section 10100.

1. Submit a "**Life of Building**" warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer's instructions and recommendations, porcelain enamel steel markerboard and chalkboard writing surfaces are guaranteed for the Life of the Building. Guarantee covers replacement of defective boards, but does not include cost of removal or reinstallation.

2. Submit a standard warranty, stating that when installed in accordance with manufacturer's instructions and recommendations, exhibition boards are guaranteed for **one (1) year** against defects in materials and workmanship. Guarantee does not cover normal wear and tear, improper handling, any misuse, or any defects caused by vandalism or subsequent abuse. Guarantee covers replacement of defective material, but does not include cost of removal or reinstallation.

3. Writing Surface Warranty Period: Lifetime of the building commencing on the Date of Substantial Completion.

O. Fire Extinguishers, Cabinets and Accessories as specified in Section 10522.

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   a. Failures include, but are not limited to, the following:
      1) Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
      2) Faulty operation of valves or release levers.
   b. Warranty Period: **Six (6) years** from date of Substantial Completion.

P. Operable Partitions as specified in Section 10650.

1. Warranty period: **Two (2) years**.
2. Suspension System Warranty: **Two (2) years**.
3. **Lifetime warranty** on hinges.

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Q. Toilet and Bath Accessories as specified in Section 10800.

1. Washroom Accessories: Warranty is limited to replacing or repairing, at the manufacturer's option, transportation charges prepaid by the purchaser, any washroom accessory unit or part thereof which their inspection shall show to have been defective within the limitation of the warranty. Period of warranty is measured from the date of their invoice as follows:
   a. Complete unit (except mirrors) - **Two (2) year**.
   b. Stainless Steel Mirror Frames - **Fifteen (15) years** - against corrosion.
   c. Tempered Glass Mirrors - **Five (5) years** - against silver spoilage.
   d. Polished #8 Architectural Grade Finish on 304 Series Stainless Steel - **Two (2) year** against corrosion.
   e. Bright Annealed Finish on 430 Series Stainless Steel - **Two (2) year** against corrosion.

   * Warranty does not cover installation labor charges and does not apply to any units which have been damaged by accident, abuse, improper installation, improper maintenance, or altered in any way.

R. Casework (Solid Wood) as specified in Section 11011.

1. Manufacturer shall warrant the casework to be free from defects in materials and workmanship, under normal use and service, for **three (3) years** from date of delivery.
   a. Within the warranty period, manufacturer shall repair, replace, or refund the purchase price of defective casework.

S. Window Treatment as specified in Section 12500.

1. Roller Shade Hardware Warranty: Manufacturer's standard non-depreciating **twenty-five (25) year limited** warranty.

2. Standard Shadecloth: Manufacturer's standard **twenty-five (25) year** warranty.

3. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating **five (5) year** warranty.

4. Roller Shade Installation: **Two (2) years** from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed Owner's responsibility.

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1.3 PLUMBING & DRAINAGE WORK

A. Electric, Domestic-Water Heaters as specified in Section 15487.

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   a. Warranty Periods: From date of Substantial Completion.
      1) Commercial, Electric, Storage, Domestic-Water Heaters:
         a) Storage Tank: **Five (5) years**.
         b) Controls and Other Components: **Two (2) years**.
      2) Compression Tanks: **Five (5) years**.

1.4 HEATING, VENTILATING, AIR CONDITIONING AND REFRIGERATION WORK

A. HVAC Instrumentation and Controls as specified in Section 15900.

1. Warranty Period: Labor and materials for control systems shall be warranted for a period as specified under Warranty in General Conditions. Provide a **two (2) year** labor and material warranty on the BMS. If within twenty four (24) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship, or materials, it shall be replaced, repaired, or adjusted at the option of the BMSC at the cost of the BMSC. THE BMSC shall maintain an adequate supply of repair devices within 50 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMSC's normal business hours.

2. Start of Warranty Date: After the Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the Engineer shall certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. The BMSC shall provide the owner in writing the Date of acceptance and the beginning of the warranty period.

3. Software Warranty: The BMSC shall provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve identified software deficiencies at no charge during warranty period. Do not install updates or upgrades without Owner's written authorization.

4. Warranty - Remote Service Support: As part of the warranty response, the BMSC shall be required to remotely connect to the facility's BMS during the warranty period. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported to the BMSC. This coverage shall include normal or after business hours, weekends, and holidays. If the problem cannot be resolved with remote support services, the BMSC shall dispatch the qualified personnel to the project site to resolve the problem within 24 hours.

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1.5 ELECTRICAL WORK

A. Digital, Addressable Fire-Alarm System as specified in Section 13852.

1. Warranty: System provider agrees to repair or replace fire-alarm system equipment and components including but not limited to the fire alarm control panel, detection devices, and notification devices that fail in materials or workmanship within specified warranty period.
   a. Warranty Period: **Five (5) years** from date of Substantial Completion.

B. Lighting Control Devices as specified in Section 16145.

1. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
   a. Failures include, but are not limited to, the following:
      1) Faulty operation of lighting control software.
      2) Faulty operation of lighting control devices.
   b. Warranty Period: **Two (2) years** from date of Substantial Completion.

C. Enclosed Switches and Circuit Breakers as specified in Section 16410.

1. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   a. Warranty Period: **Two (2) years** from date of Substantial Completion.

D. Panelboards as specified in Section 16442.

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fails in materials or workmanship within specified warranty period.
   a. Warranty Period: **Three (3) years** from date of Substantial Completion.

E. Lighting as specified in Section 16511.

1. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

2. Warranty Period: **Five (5) years** from date of Substantial Completion

F. Lighting Controls as specified in Section 16526.

1. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
   a. Failures include, but are not limited to, the following:
      1) Failure of software input/output to execute switching or dimming

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commands.
2) Failure of modular relays to operate under manual or software commands.
3) Damage of electronic components due to transient voltage surges.

b. Warranty Period: **Five (5) years** from date of Substantial Completion.
c. Extended Warranty Period Failure Due to Transient Voltage Surges: **Eight (8) years**.

G. Emergency Responder Radio System as specified in Section 16800.

1. Special Warranty: Manufacturer agrees to repair or replace ERRC system equipment and components that fail in materials or workmanship within specified warranty period.
   a. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement
   b. Warranty Period: **Five (5) years** from date of Substantial Completion

END OF SECTION 01900

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PART 2 - GENERAL CONSTRUCTION WORK

SECTION 02070 - SELECTIVE DEMOLITION

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 DESCRIPTION OF WORK

A. Extent of selective demolition Work is indicated on the Drawings.

B. Type(s) of Selective Demolition Work: Demolition requires the selective removal and subsequent offsite disposal of the following:

1. Portion(s) of building structure as indicated on Drawings, as required to accommodate new construction.

2. Removal and protection of existing fixtures and equipment items indicated as "salvage", and reinstallation and/or deliver to the Owner.

C. Removal Work Specified Elsewhere:

1. Mechanical and Electrical Work - Cutting non-structural concrete floors and masonry walls for underground piping, conduit, and for above grade piping, conduit, is included with the Work of the respective Mechanical and Electrical Trades.

D. Related Work Specified Elsewhere:

1. Remodeling construction Work and patching is included within the respective sections of Specifications, including removal of materials for re-use and incorporated into remodeling or new construction.

1.3 SUBMITTALS

A. Proposed Demolition Activities: Submit schedule indicating proposed methods and sequence of operations for selective demolition Work to Owner's Representative for review prior to commencement of Work. Provide starting and ending dates for each activity as appropriate.

1. Include coordination for shut-off, capping, and continuation of utility services, as required, together with details for dust and noise control protection.

2. Provide detailed sequence of demolition and removal Work to ensure uninterrupted progress of Owner's on-site operations.

3. Sequence construction so as to minimize obstruction of exits and provide temporary alternate exits, as required by Authorities Having Jurisdiction.

4. Coordinate with Owner's continuing occupation of portions of existing building, and with Owner's reduced usage during summer months.

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B. Photographs: Photograph existing conditions of structure, surfaces, equipment or surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's Representative prior to starting Work.

C. Project Record Documents: Indicate unanticipated structural, electrical, or mechanical conditions.

1.4 JOB CONDITIONS

A. Occupancy: Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition Work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

1. Conditions existing at time of commencement of this Contract will be maintained by Owner insofar as practicable. However, variations within structure may occur by Owner's removal and salvage operations prior to start of selective demolition Work.

C. Protections: Provide temporary barricades and other forms of protection, as required, to protect Owner's personnel and general public from injury due to selective demolition Work.

1. Provide protective measures, as required, to provide free and safe passage of Owner's personnel and general public to and from occupied portions of building.

2. Protect existing finish Work, from being damaged during the project, which is to remain in place and becomes exposed during demolition operations.

3. Protect floors with suitable coverings so as to leave the flooring in same condition at end of job.

4. Construct temporary insulated solid dustproof partitions, where required, to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors, if required.

5. Remove protections at completion of Work.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition Work at no cost to Owner, including but not limited to concealed interior and exterior utility lines not properly investigated by the Contractor, prior to commencement of demolition Work.

E. Traffic: Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from Authorities Having Jurisdiction. Provide

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alternate routes around closed or obstructed traffic ways, if required by governing regulations.

F. Explosives: Use of explosives will not be permitted.

G. Utility Services: Maintain existing interior and exterior utilities indicated to remain, keep in service, and protect against damage during demolition operations.

1. 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 governing authorities.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to commencement of selective demolition Work, inspect areas in which Work will be performed.

1. **Photograph existing conditions of structure, surfaces, equipment or surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's Representative prior to starting work.**

2. Commencement of work shall constitute acceptance of conditions. Any necessary remedial work required to correct any unsatisfactory conditions, found after the start of installation, will be provided at no cost to the Owner.

3. Prior to the commencement of work review the demolition activities with the Owner's representative to identify additional salvage items requested by the Owner.

3.2 PREPARATION

A. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition Work is performed in rooms or areas from which such items have not been removed.

B. Erect and maintain dust-proof partitions and closures, as required, to prevent spread of dust or fumes to occupied portions of the building.

1. Provide weatherproof closures for exterior openings resulting from demolition Work.

C. Locate, identify, stub off and disconnect utility services that are not indicated to remain.

1. Provide by-pass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shut-down of service is necessary during change-over.

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3.3 DEMOLITION

A. Perform selective demolition Work in a systematic manner. Use such methods, as required, to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

1. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.
    a. The Contractor shall use caution when cutting into existing masonry construction (eg.: concrete slabs, single wythe and cavity wall construction) as there may be un-documented utilities within the cavity or built into the cores of cmu wall construction or under the floor slab. The Contractor shall perform all necessary investigation prior to demolition Work to determine the presence of existing utilities within construction to be demolished, including but not limited to radar, thermal, impact echo, etc. The Contractor shall pay for restoring / repairing the existing construction if utilities are cut and proper selective demolition investigation Work was not performed. Refer to Section 01050.

2. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors or framing.

3. Provide services for effective air and water pollution controls, as required by Authorities Having Jurisdiction.

4. For interior slabs on grade, use removal methods that will not crack or structurally disturb adjacent slabs or partitions. Use power saw where possible.

B. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative / Architect in written, accurate detail. Pending receipt of directive from Owner's Representative / Architect rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.4 SALVAGE MATERIALS

A. Salvage Items: Where indicated on Drawings as "Salvage-Deliver to Owner", carefully remove indicated items, clean, store and turn over to Owner and obtain receipt.

1. Unless otherwise indicated all materials, items, equipment, etc. resulting from demolition Work shall be removed from the site at the Contractor’s expense.

B. Historic artifacts and other articles of historic significance remain the property of the Owner. Notify Owner's Representative / Construction Manager if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off-site.

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B. If hazardous materials are encountered during demolition operations, notify the Owner's Representative immediately, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.

C. Burning of removed materials is not permitted on project site.

3.6 CLEAN-UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

B. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition Work. Repair adjacent construction or surfaces soiled or damaged by selective demolition Work.

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SECTION 02150 - SHORING AND BRACING

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. Extent of shoring and bracing work includes, but is not limited to, the following:

1. Shoring and bracing necessary to protect existing building, utilities and other improvements and against collapse.

2. Maintenance of shoring and bracing.

3. Removal of shoring and bracing, as required.

B. Types of shoring and bracing system include, but are not limited to the following:

1. Column shoring. (Building Structure)

2. Scaffolding shoring. (Building Structure)

3. Cantilever shoring. (Building Structure)

1.3 SUBMITTALS

A. Layout Drawings: Provide layout drawings for shoring and bracing system and other data prepared and sealed by a registered Professional Engineer licensed in the State of the project. System design and calculations must be acceptable to local Authorities Having Jurisdiction.

1.4 QUALITY ASSURANCE

A. Supervision: Engage and assign supervision of shoring and bracing work to a qualified consultant.

B. Submit name of engaged consultant and qualifying technical experience.

C. Regulations: Comply with local codes and ordinances of governing Authorities Having Jurisdiction.

1.5 JOB CONDITIONS

A. Before starting work, check and verify governing dimensions and elevations. Survey condition of adjoining properties. Take photographs to record any prior settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs, and signed by Contractor and others conducting investigation.

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B. Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations sufficiently distant so as not to be affected by movement resulting from excavation operations.

C. During selective demolition, resurvey benchmarks weekly, employing a licensed Land Surveyor or registered Professional Engineer, licensed in the State of the project. Maintain accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags or other damage is evident.

1.6 EXISTING UTILITIES

A. Protect existing active sewer, water, gas, electricity and other utility services and structures.

B. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal and discontinuing of services, as affected by this work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide suitable shoring and bracing materials which will support loads imposed. Materials need not be new, but should be in serviceable condition.

PART 3 - EXECUTION

3.1 SHORING

A. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces and all other materials. Provide shoring system adequately anchored and braced to building loads..

3.2 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move a brace, install new bracing prior to removal of original brace.

B. Do not place bracing where it will be cast into or included in permanent work, except as otherwise acceptable to Architect.

C. Install internal bracing, if required, to prevent spreading or distortion to braced frames.

D. Maintain bracing until structural elements are rebraced by other bracing or until permanent construction is able to withstand the building loads.

E. Remove sheeting, shoring and bracing in stages to avoid damage to structures, facilities, and utilities.

F. Repair or replace, as acceptable to Architect, adjacent work damaged or displaced through installation or removal of shoring and bracing work.

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SECTION 03300 - CONCRETE WORK

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 work of this section.

1.2 SUMMARY

A. Extent of concrete work is shown on the Drawings.

B. Concrete footings.

1.3 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds and others, as required by Architect.

B. Samples: Submit samples of materials as requested by Architect, including names, sources and descriptions.

C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

D. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with Specification requirements.

E. Shop Drawings: Reinforcement: Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing diagrams of bent bars, arrangement of concrete reinforcement.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, Specifications and standards, except where more stringent requirements are shown or specified:

ASTM C94/C94M	“Specification for Ready-Mixed Concrete”
ACI 117	“Tolerances for Concrete Construction and Materials”
ACI 211.1	"Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"
ACI 301/301M	"Structural Concrete for Buildings."

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ACI 302.1R	“Guide for Concrete Floor and Slab Construction”
ACI 304R-00	"Guide for Measuring, Mixing, Transporting and Placing Concrete"
ACI 305R	"Hot Weather Concreting"
ACI 306R	"Cold Weather Concreting"
ACI 308.1	“Standard Specification for Curing Concrete”
ACI 311.1R	"ACI Manual of Concrete Inspection (SP-2)”
ACI 311.4R	“Guide for Concrete Inspection”
ACI 318	"Building Code Requirements for Reinforced Concrete", except as modified in accordance with International Building Code.

Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

B. Concrete Testing Service: The Contractor shall engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

D. Installation of Vapor Barrier: Installation shall be in accordance with manufacturer’s direction and in compliance with ASTM E 1745 “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs”.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

D. Welded Deformed Steel Wire Fabric: ASTM A 497.

E. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI Specifications.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

1. Use one brand of cement throughout project, unless otherwise acceptable to Architect.

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B. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.

C. Water: Drinkable.

D. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "WRDA" Hycol"; W.R. Grace.
   b. "Eucon WR-75" or "Eucon WR-89"; Euclid Chemical Co.
   c. "Pozzolith 322N"; Master Builders.
   d. “Plastocrete”; Sika Corp.
   e. Or approved equal

E. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.024 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "Accelguard 80"; Euclid Chemical Co.
   b. "Daraset"; W.R. Grace
   c. Or approved equal

F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D and containing not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "Pozzolith Retarder"; Master Builders.
   b. "Eucon Retarder 75"; Euclid Chemical Co.
   c. "Daratard 17"; W.R. Grace.
   d. "Plastocrete 161R"; Sika Corporation.
   e. Or approved equal

G. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.

2.3 RELATED MATERIALS

A. Non-Shrink Grout: CRD-C 621, factory pre-mixed grout.

1. Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
   a. Non-metallic:
      1) "Masterflow 713"; Master Builders
      2) "Euco-NS"; Euclid Chemical Co.
      3) "Five Star Grout"; U.S. Grout Corporation.
      4) Or approved equal

B. Absorptive Cover: Burlap cloth made from jute or kenaf weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

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C. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

D. Clear curing and sealing compound (VOC Compliant): The compound shall have 30% solids content minimum, and will not yellow under ultra violet light after 500 hours of test in accordance with ASTM D 4887 and will have test data from an independent testing laboratory indicating a maximum moisture loss of 0.039 grams per sq. cm. when applied at a rate of 300 sq. ft. per gallon. Sodium silicate compounds are not permitted.

1. Product: "Super Diamond Clear Vox" by Euclid Chemical Co.; or approved equal.

E. Vapor Barrier: Provide vapor barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in accordance with the following:

1. Thickness: 15 mils.

2. Permeance: ASTM E 96; .01 perms before and after conditioning and in accordance with ASTM E 1745 Class A requirements and ATM E 154 for mandatory conditioning tests.

3. Puncture Resistance: ASTM D 1709; 2200 grams.

4. Chemical Resistance: ASTM E 154, unaffected.

5. Life Expectancy: ASTM E 154, indefinite.

6. Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
   a. “Wrap 15-mil ” Vapor Barrier; Stego Industries, LLC.
   b. “VaporFLEX” by Layfield.
   c. “Moistop Ultra 15-mil” by Fortifiber.
   d. “Griffolyn G15" by Reef.
   e. Or approved equal.

7. Accessories: Seam tape; ASTM E 96 , 0.3 perms or lower.

8. Vapor barrier sheets with seams overlapped not less than 12".

9. **All penetrations must be sealed using a combination of the manufacturer’s tape and/or mastic.**

10. Installation shall be in accordance with manufacturer’s direction and in compliance with ASTM E 1643-98 “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs”. Include manufacturer’s recommended adhesive or pressure-sensitive tape.

F. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

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2.4 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on Drawings.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be admitted to and accepted by Architect before using in work.

E. Admixtures:

1. Use water-reducing admixture in concrete, as required for placement and workability.

2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Slabs and sloping surfaces: Not more than 3".

2. Reinforced foundation systems: Not less than 1" and not more than 3".

3. Other concrete: Not less than 1" nor more than 4"

2.5 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

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1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.2 JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate at a maximum spacing of 90 feet, so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Control Joints: Locate and install control joints as indicated or at a maximum spacing of 30 feet. Locate at a spacing which does not impair appearance of the structure as acceptable to Architect.

C. Joint filler and sealant materials are specified in Section 07900.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting Drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

B. Screed Strips for Slabs: Set bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

C. Installation of Vapor Barrier: Install materials in accordance with manufacturer's direction and in compliance with ASTM 1643-98 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs".

1. Seal all slab penetrations with manufacturer's approved or recommended tapes, sealants, adhesives, and other materials to achieve indicated testing requirements.

2. Protect vapor barrier materials during construction operation, repair or replace damaged material with new materials.

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3.4 CONCRETE PLACEMENT

A. Pre-placement inspection: Before placing concrete, inspect and complete reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other Trades in setting such work.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. General: Comply with ACI 304R-00 "Guide for Measuring, Mixing, Transporting and Placing Concrete", and as herein specified.

C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

E. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

F. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

G. Maintain reinforcing in proper position during concrete placement operations.

H. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which would be caused by frost, freezing actions or low temperatures, in compliance with ACI 306R.

I. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

J. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305R.

3.5 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces as otherwise indicated.

B. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances as follows:

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1. Ff 12 - Fl 9 For noncritical areas: mechanical rooms and surfaces to have thick-set tile.
2. Ff 15 - Fl 12 For carpeted areas
3. Ff 21 - Fl 15 For thin-set flooring
4. Ff 27 - Fl 21 For warehouse, gymnasiums.
5. Ff 30 - Fl 30 For TV studios

Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.

D. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances as follows:

1. Ff 20 - Fl 15 For noncritical areas: mechanical rooms and surfaces to have thick-set tile.
2. Ff 25 - Fl 20 For carpeted areas
3. Ff 35 - Fl 25 For thin-set flooring
4. Ff 45 - Fl 35 For warehouse, gymnasiums.
5. Ff 50 - Fl 50 For TV studios

Grind smooth surface defects which would telegraph through supplied floor covering system.

3.6 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 308 (latest edition) procedures. Avoid rapid drying at end of final curing period.

D. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing and by combinations thereof, as herein specified.

E. Provide moisture curing by following methods.

1. Keep concrete surface continuously wet by covering with water.

2. Continuous water-fog spray.

3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 12" lap over adjacent absorptive covers.

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F. Provide moisture-cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, place in widest practicable width with sides and ends lapped at least 12" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

G. **Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, flooring (such as ceramic or quarry tile, glue-down carpet, etc.), painting and other coatings and finish materials, unless otherwise acceptable to Architect.**

H. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

I. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture retaining cover, unless otherwise directed.

3.7 CONCRETE SURFACE REPAIRS

A. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

B. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable conditions.

C. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

D. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

E. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material.

3.8 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Contractor will employ and pay for a testing laboratory to perform the following tests, inspect reinforcement placement and to submit test reports. Testing laboratory must be pre-approved by the Architect.

B. Sampling and testing for quality control during placement of concrete may include the following, as directed by Architect.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

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1. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.

2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.

D. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

E. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

F. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

G. Test results will be reported in writing to Architect and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

H. Nondestructive Testing: Impact hammer, sonoscope or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

I. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests when unacceptable concrete is verified.

END OF SECTION 03300

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SECTION 03452 - CEMENT BASED SELF-LEVELING UNDERLAYMENT

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. Extent of Cement Based Self Leveling underlayment for application under flooring work as indicated on Drawings.

B. Related Sections:

1. Section 01455 - Concrete In-Situ Relative Humidity and pH Testing
2. Section 09650 - Resilient Flooring
3. Section 09900 - Painting

1.3 DEFINITIONS

A. Self- Leveling underlayment for flooring includes systems which consist of materials specially formulated, cementitious self-smoothing, rapid hardening compound to level and repair existing interior concrete slabs.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's Specifications, installation instructions and general recommendations for each major product required. Include data substantiating that products to be furnished comply with requirements of the Bid Documents.

B. Test Reports: Submit results of testing specified.

1. Certificates: Submit manufacturer's test data certifying compliance with specified performance requirements.

2. Test reports: Submit test data for moisture content and hydrostatic pressure of existing concrete slab.

C. Certificates: Submit manufacturer's certification that products comply with requirements of the Bid Documents.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain required products from a single manufacturer.

B. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of work for not less than 5 years.

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C. Installer's Qualifications: All work of this section shall be performed by an experienced applicators, licensed by the manufacturer of the system and successfully completed this type of work for the last 2 years.

D. Codes and Standards: Comply with requirements of the Bid Documents or of governing codes and Authorities Having Jurisdiction.

E. Mock-up: Prior to installation of work of this section, erect sample at location directed by or acceptable to the Architect, using specified materials and workmanship to be expected in the completed work. Once mock-up has been approved by the Architect, retain until the work has been completed and accepted.

1. Configuration: Approximately 4 feet by 4 feet.

2. Mock-up may not be incorporated into the final work; demolish and remove from site when directed by the Architect.

F. Pre-installation Conference: Prior to installation of work of this section, conduct a meeting at the project site to discuss quality assurance requirements. In addition to the Contractor and the installer, arrange for attendance of the following:

1. Other installers affected by the work of this section.
2. The Owner's Representative.
3. Construction Manager
4. The Architect.
5. Manufacturer's Representative.
6. Supplier.

G. Allowable Tolerances:

1. Variation from Level: Do not exceed 1/4 inch in any bay or 10 feet in distance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Keep materials dry at all times. Protect against exposure to weather and against contact with damp or wet surfaces.

B. Store materials on one site to maintain proper separation and grading integrity. Cover materials to prevent excessive accumulation of moisture.

C. Protect materials from excessive moisture in shipment, storage, and handling. Deliver materials in manufacturer's unopened packages, and store in dry place with adequate air circulation.

D. Storage: Stack products of this section carefully to provide air circulation within stacks.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not proceed with installation when air temperatures are below 40°F, or above 95°F, unless protective measures acceptable to the manufacturer are taken.

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B. Do not proceed with installation until temperature and relative humidity have been stabilized and will be maintained within values established by the manufacturer for optimum quality control.

C. Provide adequate ventilation to prevent accumulation of hazardous fumes during application of components in enclosed spaces, and maintain ventilation until materials have thoroughly cured.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate work of this section with other Trades and installation of special construction and equipment.

1.9 WARRANTY

A. Special Project Warranty: Submit a written warranty signed by the manufacturer, the Contractor, and the installer, guaranteeing to correct failures in materials and workmanship which occur within the warranty period, including those attributable to abnormal aging, without reducing or otherwise limiting any other rights to correction which the Owner may have under the Bid Documents.

1. The warranty shall include responsibility for removing and replacing other work as necessary to accomplish repairs or replacement of materials covered by the warranty.
   a. Special Warranty period: **Two (2) years** after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: "Ultraplan Easy" or "Ultraplan 1 Plus", as manufactured by Mapei Corporation; or approved equal.

B. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. "Silflo 230", as manufactured by Silpro, LLC,
2. "K15 ", as manufactured by Ardex, Inc.,
3. Equivalent system from USG,
4. Or approved equal

2.2 MATERIALS

A. Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in uniform thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations to 2" in a single lift.

1. Cement Binder: ASTM C 150, Portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C-219.

2. Compressive Strength: Not less than 4,100 psi at 28 days when tested according to ASTM C109.

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B. PHYSICAL PROPERTIES - (Basis of Design)

1. Provide self - leveling underlayment system in which physical properties of topping including aggregate, which meets or exceeds the following requirements:
   a. Compressive Strength: ASTM C109, greater than 4,100 psi. after 28 days.
   b. Flexural Strength: ASTM C348, greater than 1,070 psi after 28 days.
   c. Final set at 50 - 95°F: 2 - 3 hours.
   d. Time required before installation of stile: Typically 3 hours

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect substrates and conditions under which the work of this section will be performed, and verify that installation properly may commence. Do not proceed with the work until unsatisfactory conditions have been resolved fully.

1. Commencement of work shall constitute acceptance of conditions. Any necessary remedial work required to correct any unsatisfactory conditions, found after the start of installation, will be provided at no cost to the Owner.

B. Testing: Perform required testing of existing concrete slab, for hydrostatic pressure and moisture content. Follow manufacturer's recommended procedures for testing slab. Do not proceed with the work until unsatisfactory conditions have been resolved fully.

3.2 PREPARATION

A. Clean substrate, removing projections, all loose material and substances detrimental to the work; comply with recommendations of manufacturer of products to be installed for proper preparation procedures.

B. Prepare substrate in accordance with recommendations of manufacturer for optimum installed performance.

C. Mask off or otherwise protect adjacent surfaces not scheduled to receive products of this section.

D. Coordinate installation with other trades, report conditions in writing to the Owner/Architect. Do not proceed with application work until any unsatisfactory conditions have been corrected.

3.3 APPLICATION

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 the work.

1. Apply materials in a featheredge to 2" per lift, thickness as required to suite actual condition(s).

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3.4 CLEANING

A. Upon completion, clean all surfaces which have become soiled or coated as a result of work of this section, using proper methods which will not scratch or otherwise damage finished surfaces.

B. For cleaning, use only products and techniques acceptable to manufacturer of products being cleaned.

3.5 PROTECTION

A. General: Institute protective procedures and install protective materials as required to ensure that work of this section will be without damage or deterioration.

END OF SECTION 03452

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SECTION 04200 - UNIT MASONRY

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 DESCRIPTION OF WORK

A. Extent of each type of masonry Work is indicated on Drawings.

B. Type of masonry Work required includes:

1. Concrete unit masonry.
2. Mortar and grout.
3. Reinforcement, anchorage, and accessories.
4. Concrete masonry lintels and bond beams.
5. Installation of miscellaneous loose steel lintels, plates and other steel fabrications.

C. Related Work:

1. Section 07900 - Joint Sealer Assemblies
2. Section 08110 - Hollow Metalwork
3. Section 09250 - Gypsum Drywall
4. Section 09650 - Rubber Base
4. Section 09900 - Painting of exposed to view CMU surfaces

1.3 QUALITY ASSURANCE

A. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by a recognized testing and inspecting organization or by another means, as acceptable to Authority Having Jurisdiction.

B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and filed, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

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E. Masonry Pre-Installation Meeting: Prior to installation of any above-grade masonry Work, there shall be a Masonry Pre-Installation Meeting between the General Contractor, all masonry Subcontractors (if any), and the Architect. At this meeting, all masonry construction products and procedures shall be reviewed.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.

B. Samples for Verification Purposes: Submit the following samples:

1. Unit masonry samples for each type of exposed masonry unit required; include in each set the full range of exposed color and texture to be expected in completed Work.

C. Shop Drawings: Submit shop drawings for the following:

1. All locations of Vertical Control Joints for interior concrete masonry unit walls including control joints shown or required.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

C. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.

D. Store cementitious materials off the ground, under cover and in dry location.

E. Store aggregates where grading and other required characteristics can be maintained.

F. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

1.6 REFERENCE STANDARDS

A. Comply with the current applicable provisions of all codes, regulations, industry standards and specifications referenced in this section, unless otherwise modified by the requirements of the Bid Documents, including but not limited to the following:

1.	ACI 531	Building Code Requirements for Masonry Structures.
2.	ACI 531	Commentary on Building Code Requirements for Masonry Structures.
3.	ACI 530.1	Specification for Masonry Construction.
4.	ASTM C129	Non-Load Bearing Masonry Units.
5.	ASTM C140	Testing Concrete Masonry Units.
6.	ASTM C270	Standard Specification for Mortar for Unit Masonry

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7. ASTM C780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
8. ASTM C1586 Standard Guide for Quality Assurance of Mortars.
9. NCMA TEK Bulletins.

1.7 PROJECT CONDITIONS

A. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls.

B. Do not apply concentrated loads for at least 3 days after building masonry walls.

C. Staining: Prevent grout or mortar from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

D. Protect sills, ledges and projections from droppings of mortar.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer: Obtain masonry units from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas.

1. Concrete Masonry Units: Subject to compliance with requirements, manufacturers of concrete masonry units which may be incorporated in the Work include, but are not limited to, the following:
   a. Anchor Concrete Products Inc.
   b. Clayton Block Co., Inc.
   c. Oldcastle APG.
   d. Or approved equal.

2. Masonry Anchors, Joint Reinforcing, Accessories, etc.: Subject to compliance with requirements, manufacturers of masonry anchors, joint reinforcing, accessories which may be incorporated in the Work include, but are not limited to, the following:
   a. Heckman Building Products, Inc.
   b. Hohmann & Barnard, Inc.
   c. Or approved equal.

2.2 CONCRETE MASONRY UNITS

A. General: Comply with referenced standards and other requirements indicated below applicable to form of concrete masonry unit required.

B. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

1. Provide bullnose units for outside corners unless otherwise indicated.

C. Concrete Block: Provide units complying with characteristics indicated below for face size, exposed face and under each form of block included, for weight classification.

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D. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated.

E. Hollow Loadbearing Block: ASTM C90 and as follows:

1. Weight Classification: Lightweight.

F. Solid 4" and 6" CMU (2 and 3 Hour Fire Resistance Rated) Loadbearing Block: Standard Method for Determining Fire Resistance of Concrete and Masonry Assemblies - ANSI/ACI 216.1-97, TMS-0216-97 and as follows:

1. Construction and material requirements of concrete masonry including units, mortar, grout, control joint materials and reinforcement shall comply with ACI 530/ASCE 5/TMS 402.

2. Concrete masonry units shall comply with ASTM C55, C73, C90 or C129.

3. Weight Classification: Lightweight.

4. Aggregate Type: Expanded clay, expanded shale or expanded slate with a minimum required equivalent thickness of 3.6 inches for 4" CMU.

2.3 MORTAR AND GROUT MATERIALS

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Limit cementitious materials in mortar to portland cement-lime.

C. Portland Cement: ASTM C150, Type 1, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.

D. Hydrated Lime: ASTM C207, Type S.

E. Aggregate for Mortar: ASTM C144, except for joints less than 1/4 inch use aggregate graded with 100% passing the No. 16 sieve.

1. White Mortar Aggregates: Natural white sand or ground white stone.

F. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification, for types of mortar required, unless otherwise indicated.

G. Grout for Unit Masonry: Comply with ASTM C476.

1. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.

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H. The proper use of ASTM C270 and Test Method ASTM C780 for evaluating masonry mortars produced in the laboratory and the construction site is in accordance with ASTM C1586.

I. Aggregate for Grout: ASTM C404.

J. Water: Clean and potable.

2.4 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

A. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:

1. Hot-Dip Galvanized Steel Wire: ASTM A82 for uncoated wire and with ASTM A153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

B. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 2 inch less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8 inch on joint faces exposed to exterior and ½ inch elsewhere.
   a. Wire Size for Side Rods: 9 gauge.
   b. Wire Size for Cross Rods: 9 gauge.

2. Ladder design rods spaced not more than 16 inch o.c.

3. Number of Side Rods: One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.

4. Configuration:
   a. Applications of Single Wythe Wall width: Ladder type design rods at not more than 16 inches on center.
      1) Basis of Design: Provide Hohmann & Barnard, Inc., No.# 220, Ladder-Mesh; or approved equal.

C. Flexible Anchors: Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.

1. For anchorage to steel framework provide manufacturer's standard anchors with triangular-shaped wire tie section sized to extend within 1 inch of masonry face. Coordinate with Steel Subcontractor for type and size required. Provide 3/16 inch diameter, hot-dip galvanized steel.

D. Unit Type Masonry Inserts in Concrete: Furnish cast iron or malleable iron inserts of type and size indicated.

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E. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM A307, Grade A, hot-dip galvanized to comply with ASTM C153, Class C, in sizes and configurations indicated.

F. Pencil rods at construction joints as shown: Dowels dipped in tar for ½ of length.

2.5 MASONRY LINTELS

A. General: Provide one of the following:

1. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMU's matching adjacent CMU's in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Non-Metallic Expansion Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D1056, Grade 2A1, capable of compression up to 35%, of width and thickness indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not wet concrete masonry units.

B. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

C. Thickness: Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

D. Build chases and recesses as shown or required for the Work of other Trades. Provide not less than 8 inch of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

E. 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.

F. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining Work. Use full-size units without cutting where possible. No discoloration of units caused by cutting will be acceptable.

G. Pattern Bond:

1. Concrete masonry units: Running bond, unless otherwise shown.

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2. Lay concealed masonry with all units in a wythe bonded by lapping not less than 2 inches.

3.2 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4 inch in 10 feet, or 3/8 inch in a story height not to exceed 20 feet, nor ½ inch in 40 feet or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4 inch in any story or 20 feet maximum, nor ½ inch in 40 feet or more. For vertical alignment of head joints do not exceed plus or minus 1/4 inch in 10 feet, ½ inch maximum.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4 inch in any bay or 20 feet maximum, nor ½ inch in 40 feet or more. For top surface of bearing walls do not exceed 1/8 inch between adjacent floor elements in 10 feet or 1/16 inch within width of a single unit.

C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed ½ inch in any bay or 20 feet maximum, nor 3/4 inch in 40 feet or more.

D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4 inch nor plus ½ inch.

E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to ½ inch. Do not exceed head joint thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other Work.

C. Stopping and Resuming Work: Rack back ½-unit 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: 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.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

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3. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

E. Extend all interior walls full height to underside of structure of deck, unless otherwise indicated. Include compressible insulation at top to completely close space between wall and structure above.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on concrete floor slab.

B. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8 inch joints.

C. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.

D. Tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated.

E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

3.5 HORIZONTAL JOINT REINFORCEMENT

A. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, ½ inch elsewhere. Lap reinforcing a minimum of 6 inches.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.

1. Space continuous horizontal reinforcement as follows:
   a. For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.

2. Cut reinforcement units at walls intersecting and/or abutting firewalls. Provide control joints with fire-rated sealant as indicated in Section 07900.

D. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints.

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3.6 ANCHORING MASONRY WORK

A. Provide anchoring devices of the type indicated. If not indicated, provide standard type for facing and back-up involved.

1. Strap anchors for masonry at existing walls.

2. Do not anchor fire walls to Structural Steel, intersecting and/or abutting walls.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry maximum 30 feet on center. Build-in related items as the masonry Work progresses.

1. Coordinate location of all control and expansion joints in the field with Architect prior to commencement of Work.

B. Build in joint fillers where shown: See Section 07900, Joint Sealer Assemblies. Joint width for sealants: 3/8 inch unless otherwise indicated. Include straight joints at vertical recessed brick detail.

3.8 LINTELS

A. Install loose lintels weighing 200 lbs. or less of steel and other materials where shown.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent Work to provide a neat, uniform appearance, prepared for application of sealants.

C. Clean exposed CMU masonry by dry brushing at the end of each day's Work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA TEK Bulletin No. 28.

1. Prepare exposed to view CMU surfaces to receive paint coatings in accordance with Section 09900.

END OF SECTION 04200

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SECTION 05400 - MISCELLANEOUS STRUCTURAL STEEL

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 DESCRIPTION OF WORK

A. Definition: Miscellaneous structural steel includes items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of Structural Steel or other metal fabrication systems specified elsewhere.

B. Extent of miscellaneous structural steel fabrications is indicated on Drawings.

1. Work of this section shall include miscellaneous structural steel framing and supports for floor, wall and roof openings whether or not shown on Architectural Drawings.
   a. Refer to Architectural, Mechanical and Electrical Drawings for the following:
      1) Locations and sizes of roof penetrations, roof top supported mechanical and electrical equipment, etc.
      2) Locations and sizes of wall penetrations, wall chases, louvers, duct penetrations, etc.
   b. All miscellaneous structural steel supports shall be in accordance with typical structural steel details and schedules shown on Architectural Drawings and/or as directed by the Architect.
   c. All miscellaneous structural steel supports shall meet indicated load requirements and/or as directed by the Architect.
   d. In existing building where alteration and/or renovation work is/are indicated, refer to Division 1 Sections for miscellaneous structural steel framing and supports which may be assigned to be provided and installed by other Trades.

C. Types of work in this section include metal fabrications for:

1. Loose Steel lintels, bearing and leveling plates and miscellaneous steel framing and supports.

D. Related Sections:

1. Section 01400 - Testing Laboratory Service
2. Section 04200 - Unit Masonry
3. Section 09900 - Painting
4. Division 15 - Mechanical Work

1.3 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 fabrications might delay work.

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B. Shop Assembly: Preassemble 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 reassembly and coordinated installation.

C. Delegated Design:

1. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Bid Documents, provide products and systems complying with specific performance and design criteria indicated. Designated Design includes, but is not limited to:
   a. Miscellaneous steel framing, metal framing, hangers, clips, brackets, bearing plates and other components.

2. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where the Project is located, (State of New Jersey), and experienced in providing engineering services of the kind indicated that have resulted in the installation of structural assemblies, similar to this Project in material, design, and extent and that has a record of successful in-service performance. Provide analysis data and signed & sealed documents.

3. Conform to all applicable State and Local Codes for design loads and all other requirements.

4. Refer to paragraph 1.4 - SUBMITTALS (below).

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code–Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's Specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.

B. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous steel fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.

1. Submit shop drawings for miscellaneous steel framing and supports. Signed and sealed shop drawings shall be submitted by a qualified professional Structural Engineer, licenced in the state where the project is located.

C. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties and other information needed for structural analysis.

D. Samples: Submit 2 sets of representative samples of materials and finished products as may be requested by Architect.

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PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: For fabrication of miscellaneous structural steel 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.

B. Steel

1. Steel Plates, Shapes and Bars: ASTM A36.

2. Structural Steel Sheet: Hot-rolled, ASTM A570; or cold-rolled ASTM A611, Class 1; of grade required for design loading.

3. Galvanized Structural Steel Sheet: ASTM A446, of grade required for design loading. Coating designation as indicated, or if not indicated, G90.

4. Gray Iron Castings: ASTM A48, Class 30.

5. Malleable Iron Castings: ASTM A47, grade as selected by fabricator

C. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

D. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

E. Grout:

1. Metallic Non-Shrink Grout: Pre-mixed, factory-packaged, ferrous aggregate grout complying with CE CRD-C588, Type M.

2. Non-Shrink Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with CE CRD-C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

F. 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 A307, Grade A.

3. Lag Bolts: Square head type, FS FF-B-561.

4. Machine Screws: Cadmium plated steel, FS FF-S-92.

5. Wood Screws: Flat head carbon steel, FS FF-S-111.

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6. Plain Washers: Round, carbon steel, FS FF-W-92.

7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

G. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.

1. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

H. Paint:

1. Surface Preparation: SSPC-2P6 commercial Blast Cleaning.

2. Primer: Tnemec Series 90-97 Tneme-Zinc, or equal, @ 2.5 - 3.5 mils (dry)

3. Primer selected must be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 09900.

2.2 FABRICATION, GENERAL

A. Workmanship: Use materials of size and thickness indicated, or if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

C. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts.

E. Provide for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

F. Shop Painting

1. Shop paint miscellaneous structural steel, except members or portions of members to be embedded in masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.

2. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-6.

3. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.

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4. Apply one shop coat to fabricated metal items, except apply two 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 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in masonry construction. Coordinate delivery of such items to project site.

1. Coordinate work of this section with other work affected by other Trades.

2. Obtain locations, opening sizes, weighs and other required information from affected Trades.

3. Comply with coordination requirements indicated in Division 1 Sections.

3.2 INSTALLATION

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 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, plus, 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 masonry or similar construction.

C. 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. Set loose lintels weighing more than 200 pounds, leveling and grouting as for plates.

3.3 ADJUST AND CLEAN

A. 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.

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B. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. For galvanize surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION 05400

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SECTION 05500 - METAL FABRICATIONS

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 DESCRIPTION OF WORK

A. Definition: Metal fabrications include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere and non-ferrous items listed herein.

B. Type of work in this section includes metal fabrications for assemblies which include but are not limited to the following:

1. Rough hardware.
2. Miscellaneous structural shapes.
3. Aluminum Mullion Mate Partition Closures.
4. Post Installed Anchors.

C. Related Work:

1. Section 03300 - Concrete Work.
2. Section 04200 - Unit Masonry.
3. Section 05120 - Structural Steel.
4. Section 05300 - Metal Decking.
5. Section 05400 - Miscellaneous Structural Steel.
6. Section 09520 - Gypsum Drywall.
7. Section 09900 - Painting.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

ASTM A108-99 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.

ASTM A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A276-03 - Standard Specification for Stainless Steel Bars and Shapes.

ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

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ASTM A563-00 - Standard Specification for Carbon and Alloy Steel Nuts.

ASTM A569/A569M-91a – Standard Specification for Steel, Carbon (.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality (superseded by A1011).

ASTM A780-01 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

ASTM A1011/A1011M-03 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

ASTM F844-00 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

AWS D1.1/D1.1M: Structural Welding Code - Steel, Welding qualification procedures and personnel.

B. 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 fabrications might delay work.

C. Shop Assembly: Preassemble 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 reassembly and coordinated installation.

D. Delegated Design Engineer Qualifications: A professional Engineer who is legally qualified to practice in New Jersey where Project is located and who is experienced in providing engineering services of the type indicated.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's Specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.

B. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others.

C. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computations, material properties and other information needed for structural analysis.

D. Samples: Submit 2 sets of representative samples of materials and finished products as may be requested by Architect.

E. Mill test reports: Reports indicating metals to be furnished comply with project requirements.

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PART 2 - PRODUCTS

2.1 MATERIALS

A. 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.

B. 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 recommended by the aluminum producer or finisher, with not less than the strength and durability properties specified in ASTM B 632/B 632 M, alloy 6061-T6.

2. 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.

3. Fasteners: Finish 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.

4. Bituminous Paint: SSPC-Paint (cold-applied asphalt mastic).

5. Protective Lacquer: Clear non-yellowing, of type recommended by metal producer for protection of the finished metal surfaces.

6. Aluminum Pipe and Tube: ASTM B429, Alloy 6063-T6.

7. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

8. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

9. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

C. Steel

1. Steel Plates, Shapes and Bars: ASTM A36/A 36M.

2. Structural Steel Sheet: Hot-rolled, ASTM A570; or cold-rolled ASTM A611, Class 1; of grade required for design loading.

D. Gray Iron Castings: ASTM A48, Class 30.

E. Malleable Iron Castings: ASTM A47, grade as selected by fabricator.

F. Stainless Steel Sheet, Strip, Plate and Flat Bars: ASTM A666, Type 304, unless otherwise indicated.

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1. Stainless Bars and Shapes: ASTM A276, Type 304.

G. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

I. Grout:

1. Non-Shrink, Metallic Grout: Pre-mixed, factory-packaged, ferrous-aggregate grout complying with CE CRD-C588, Type M, and ASTM C1107, specifically recommended by manufacturer for heavy-duty loading applications and not to be used in wet areas or on exterior applications.

2. Non-Shrink, Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with CE CRD-C621, and ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

J. Fasteners:

1. General: Provide zinc-plated fasteners complying with ASTM B633, Class Fe/Zn 5, for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

2. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563; and where needed, flat washers.

3. Weathering Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A325, Type 3, with hex nuts, ASTM A563, Grade C3; and where needed, flat washers.

4. Lag Screws: Square head type, ASME B18.2.1.

5. Machine Screws: Cadmium plated steel, ASME B18.6.3.

6. Wood Screws: Flat head, carbon steel, ASME B18.6.1.

7. Plain Washers: Round, carbon steel, ASME B18.22.1.

8. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

9. Expansion Anchors: Anchor bolt and sleeve assembly; Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.

10. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as needed.

11. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

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12. Anchor Bolts: ASTM F 1554, Grade 36, of dimension indicated; with nuts, ASTM A563; and where indicated, flat washers.

K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.

L. Cast-in-Place in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

M. Post-Installed Anchors:

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5, unless otherwise indicated.

N. Paint:

1. Metal Primer Paint: Red lead mixed pigment, alkyd varnish, linseed oil paint, FS TT-P-86l, Type II; or red lead iron oxide, raw linseed oil, alkyd paint, Steel Structures Painting Council (SSPC) Paint 2-64; or basic lead silico chromate base iron oxide, linseed oil, alkyd paint, FS TT-P-615, Type II.

2. Primer selected must be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 09900.

3. Galvanizing Repair Paint: High-zinc-dust content paint for regalvanizing welds in galvanized steel, complying with the Military Specifications MIL-P-21035 (Ships) or SSPC-Paint-20 and compatible with paints specified to be used over it.

2.2 FABRICATION, GENERAL

A. Workmanship

1. Use materials of size and thickness indicated, or if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.

2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

3. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

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4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts.

5. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

6. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

B. Shop Painting

1. Shop paint miscellaneous metal work, except members of portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.

2. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 "Hand Tool Cleaning", or SSPC SP-3 "Power Tool Cleaning", or SSPC SP-7 "Brush-Off Blast Cleaning".

3. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".

4. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions, and at a rate to provide uniform dry film thickness of 2.0 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.

5. 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.

2.4 MISCELLANEOUS METAL FABRICATIONS

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 as 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 structural connections; elsewhere, furnish steel washers.

B. Miscellaneous Structural Shapes, Framing and Supports, Etc.

1. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.

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2. Fabricate miscellaneous units to sizes, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise indicated, fabricated from structural steel shapes, plates and steel bars of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

3. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

4. Galvanize exterior miscellaneous frames and supports.

C. Aluminum Mullion Mate Partition Closures:

1. Basis of Design: Provide "Mullion-Mate I", "Mullion-Mate II", "Double Mullion-Mate I" and/or "Double Mullion-Mate II" (size as indicated on the Drawings), as manufactured by Gordon Inc.; or approved equal.
   a. Subject to compliance with requirements of the Bid Documents, manufacturers offering products which may be incorporated in work include the following:
      1) "QuietJoint® Mass-Loaded Acoustic Partition Closure" as manufactured by EMSEAL Joint Systems Ltd.
      2) Or approved equal.

2. Finish and Color: As selected by the Architect from manufacturer's available full ranges of finishes and colors.

3. Provide units complete with manufacturer's acoustical batt to achieve STC 38 rating.

2.4 MISCELLANEOUS MATERIALS

A. Injectable Mortar: Provide and install injectable mortar at all post-installed anchors, as follows:

1. Except where indicated on the Drawings, post-installed anchors shall consist of the following anchor types as provided by Hilti, Inc.; or approved equal.
   a. Anchorage to Concrete
      1) Adhesive anchors for cracked and uncracked concrete:
         a) Hilti HIT-HY 200 Safe Set System with Hilti HIT-Z ROD; or approved equal, per ICC ESR-3187.
         b) Hilti HIT-HY 200 Safe Set System with Hilti Hollow Drill Bit System with HAS-E threaded rod; or approved equal, per ESR-3187.
         c) Hilti HIT-RE 500-SD Epoxy Adhesive Anchoring System with HAS-E Threaded Rod; or approved equal, per ICC ESR-2322 for slow cure applications.
      2) Medium duty mechanical anchors for cracked and uncracked concrete:
         a) Hilti KWIK HUS-EZ and KWIK HUS EZ-I Screw Anchors; or approved equal, per ICC ESR-3027.
         b) Hilti KWIK BOLT-TZ Expansion Anchors; or approved equal, per ICC ESR-1917.
         c) Hilti KWIK BOLT 3 Expansion Anchors; or approved equal, (uncracked concrete only) per ICC ESR-2302.

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3) Heavy Duty mechanical anchors for cracked and uncracked concrete:
   a) Hilti HDA Undercut Anchors; or approved equal, per ICC ESR 1546.
   b) Hilti HSL-3 Expansion Anchors per ICC ESR 1545.

b. Rebar Doweling into Concrete
   1) Adhesive anchors for cracked and uncracked concrete use:
      a) Hilti HIT-HY 200 Safe Set System with Hilti Hollow Drill Bit System; or approved equal, with continuously deformed rebar per ICC ESR-3187.
      b) Hilti HIT-RE 500-SD Epoxy Adhesive Anchoring System; or approved equal, with continuously deformed rebar per ICC ESR-2322.

c. Anchorage to Solid Grouted Masonry
   1) Adhesive Anchors:
      a) Hilti HIT-HY 70 Masonry Adhesive Anchoring System; or approved equal, (ICC pending).
      b) Steel anchor element shall be Hilti HAS-E Continuously Threaded Rod; or approved equal, or continuously deformed steel rebar.
   2) Mechanical Anchors:
      a) Hilti KWIK HUS-EZ Screw Anchor; or approved equal, per ICC ESR-3056.
      b) Hilti KWIK BOLT-3 Expansion Anchors; or approved equal, per ICC ESR-1385.

d. Anchorage to Hollow/Multi-Wythe Masonry
   1) Adhesive Anchors:
      a) Hilti HIT-HY 70 Masonry Adhesive Anchoring System; or approved equal, per ICC ESR-3342.
      b) Steel anchor element shall be Hilti HAS-E Continuously Threaded Rod; or approved equal, or continuously deformed steel rebar.
      c) The appropriate size screen tube shall be used per adhesive manufacturer's recommendation.

2. Anchor capacity used in design shall be based on the technical data published by Hilti; or approved equal, or such other method as approved by the Architect. Substitution requests for alternate products must be approved in writing by the Architect. Contractor shall provide calculations demonstrating that the substituted product is capable of achieving the performance values of the specified product. Substitutions will be evaluated by their having an ICC ESR showing compliance with the relevant building code for seismic uses, load resistance, installation category, and availability of comprehensive installation instructions. Adhesive anchor evaluation will also consider creep, in-service temperature and installation temperature.

3. Install anchors per the manufacturer instructions, as included in the anchor packaging.

4. Overhead adhesive anchors must be installed using the Hilti Profi System; or approved equal.

5. The Contractor shall arrange an anchor manufacturer's representative to provide on-site installation training for all of their anchoring products specified. The Architect must receive documented confirmation that all of the Contractor's personnel who install anchors are trained prior to the commencement of installing anchors.

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6. Anchor capacity is dependant upon spacing between adjacent anchors and proximity of anchors to edge of concrete. Install anchors in accordance with spacing and edge clearances indicated on the Drawings.

7. Existing reinforcing bars in the concrete structure may conflict with specific anchor locations. Unless noted on the Drawings that the bars can be cut, the Contractor shall review the existing structural drawings (if available) and shall undertake to locate the position of the reinforcing bars at the locations of the concrete anchors, by Hilti Ferroscan, GPR, X-Ray, chipping; or other approved equal means.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION

A. General

1. 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.

2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plus, 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.

3. 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.

4. 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.

B. Setting Loose Lintels and Plates:

1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

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2. Set Loose Lintels, leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUST AND CLEAN

A. 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 2.8 mils.

B. For galvanize surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint.

END OF SECTION 05500

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SECTION 06100 - CARPENTRY

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. Type of work in this section includes rough carpentry for:

1. Dimensional lumber,
2. Wood nailers and blocking,
3. Rough hardware,
4. Construction panels.

1.3 SUBMITTALS

A. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of American Lumber Standards Committee.

B. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of treated material.

C. Fire-Retardant Treatment: Include certification by treating plant that treated material complies with specified standard and other requirements.

1.4 PRODUCT HANDLING

A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

B. Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.5 PROJECT CONDITIONS

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of nailers, blocking and similar supports to allow attachment of other work.

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B. Maintain temperature and humidity in installation areas as required to maintain moisture content of installed finish carpentry within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity conditions.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Inspection Agencies: Inspection agencies and the abbreviations used to reference with lumber grades and species include the following:

1. WWPA - Western Wood Products Association.

C. 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.

D. 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.

E. Provide dressed lumber, S4S, unless otherwise indicated.

F. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing.

2.2 DIMENSION LUMBER

A. For light framing (2" to 4" thick, 2" to 4" wide) provide the following grade and species:

1. Construction grade: Any species of specified grade.

B. For structural framing (2" to 4" thick, 5" and wider), provide the following grade and species:

1. Any species and grade which meets or exceeds the following values:
   a. Fb (minimum extreme fiber stress in bending); 1500 psi.
   b. E (minimum modulus of elasticity); 1,500,000 psi.

C. For exposed framing lumber provide material complying with the following requirements:

1. Definition: Exposed framing refers to dimension lumber which is not concealed by other work and is indicated to receive a stained or natural finish.

2. Grading: Hand select material at factory from lumber of species and grade indicated below for compliance with "Appearance" grade requirements of ALSC National Grading Rule; issue inspection certificate of inspection agency for selected material.

3. Same species and grade as indicated for structural framing.

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2.3 MISCELLANEOUS LUMBER

A. Provide wood for support or attachment of other work including nailers, blocking and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

1. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

2. Grade: Construction Grade light framing size lumber of any species or board size lumber as required. Provide construction grade boards or No. 2 Boards.

2.4 CONSTRUCTION PANELS

A. Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with American Plywood Association (APA) "Performance Standard and Policies for Structural-Use Panels", Form No. E445.

B. Trademark: Factory-mark each construction panel with APA trademark evidencing compliance with grade requirements.

C. Concealed APA Performance-Rated Panels: Where construction panels will be used for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable) and thickness.

D. APA RATED SHEATHING

1. Exposure Durability Classification: EXTERIOR.
   a. Span Rating: As required to suit joist spacing indicated.

E. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

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a. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners and Anchorages: 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. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

B. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

C. Building Paper: ASTM D 226, Type I; asphalt saturated felt, non-perforated, 15-lb. type.

2.6 WOOD TREATMENT BY PRESSURE PROCESS

A. Fire-Retardant Treatment: Where fire-retardant treated wood ("FRT") is indicated or required, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, identify "FRT" lumber with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection or other testing and inspecting agency acceptable to Authorities Having Jurisdiction.

1. Fire treated wood shall have a flame spread of 25 or less and shall be dried to 19% moisture content for lumber and 15% for plywood. Exposed wood or wood subject to high humidity conditions shall be identified that the moisture content shall not exceed 28% when tested at 92% relative humidity in accordance with ASTM D3201.

2. Treatment products: The following products, provided they comply with requirements of the contract documents will be among those considered acceptable:
   a. "Dricon"; Hickson Corporation.
   b. "Flame Proof LHC"; Osmose Wood Preserving, Inc.
   c. "Pyro-Guard"; Hoover Treated Wood Products, Inc.
   d. Or approved equal.

3. Treat members shown on Drawings and/or as required to meet the code requirements.

PART 3 - EXECUTION

3.1 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 to required levels and lines, with members plumb and true to line and cut and fitted.

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C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

D. Countersink nail heads on exposed carpentry work and fill holes.

E. 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.

3.2 WOOD NAILERS AND BLOCKING

A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work.

C. Height of nailers shall be matched to that of the insulation being used. Nailers shall be firmly anchored to the deck to resist a force of seventy-five pounds per lineal foot. The type of anchors shall be as recommended by the roofing manufacturer and shall be secured at intervals required to ascertain a resistance force of seventy-five pounds per lineal foot.

3.3 INSTALLATION OF CONSTRUCTION PANELS

A. General: Comply with applicable recommendations contained in Form No. E 30F, "APA Design/Construction Guide - Residential & Commercial," for types of construction panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Sheathing: Screw to framing or substrates.

END OF SECTION 06100

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SECTION 06650 - SOLID POLYMER FABRICATIONS

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. Countertops / Backsplashes.
2. Window stools.
3. Wall caps.

B. Related Sections:

1. Section 05500 - Metal Fabrications
2. Section 06100 - Carpentry
3. Section 06400 - Architectural Woodwork
4. Section 07900 - Joint Sealer Assemblies
5. Section 09250 - Gypsum Drywall.
6. Section 11011 - Casework and Equipment

1.3 SUBMITTALS

A. Product Data: Written technical information for unit specified. Indicate product description, fabrication information and compliance with specified performance requirements.

B. Shop Drawings:

1. Submit rough-in drawings. Include the following details and all other information necessary to demonstrate compliance with Bid Documents:
   a. Dimensions.
   b. Required clearances.
   c. Methods of assembling components.
   d. Anchorages.
   e. Coordination requirements with adjacent work.

C. Samples: Submit minimum 2 inch by 2 inch samples. Indicate full range of colors and pattern variation. Approved samples will be retained as a standard for work.

D. Certificates: Submit certification that work complies with requirements of Bid Documents.

E. Manufacturer's Instructions: Submit for each product specified in this section.

1. Include installation instructions and instructions for examination, preparation, and protection of adjacent work.

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F. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions and maintenance video.

1. Provide maintenance kit for indicated finishes. Include in project close-out documents.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver no components to project site until areas are ready for installation. Store indoors.

B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.5 CLOSEOUT SUBMITTALS

A. Operational and Maintenance Data:

1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.

2. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with the Owner upon completion.

1.6 QUALITY ASSURANCE

A. Allowable Tolerances: Variation in component size: ±1/8 inch.

1.7 WARRANTY

A. Provide manufacturer's warranty against defects in materials, fabrication and installation, excluding damages caused by physical or chemical abuse or excessive heat. Warranty shall provide for replacement or repair of material and labor for a period of **ten (10) years**, beginning at Date of Substantial Completion.

1. For fabrications with installed warranty coverage, identify by affixing manufacturer's fabrication/installation source plate.

PART 2 - PRODUCTS

2.1 SOLID POLYMER FABRICATIONS:

A. Basis of Design: Corian Surfaces as manufactured by Du Pont De Nemours & Co., Inc.; or approved equal.

B. Material: Cast, filled, acrylic; not coated, laminated or of composite construction, meeting ANSI Z124 1980, Type Six, and FS WW-P-541E/GEN dated August 1, 1980.

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2.2 PERFORMANCE CHARACTERISTICS:

PROPERTY	REQUIREMENT (min/max)	TEST PROCEDURE
Tensile Strength	5000 psi min	ASTM D638
Tensile Modulus	1.0×10^{6} psi min	ASTM D638
Flexural Strength	7000 psi min	ASTM D790
Flexural Modulus	1.0×10^{6}	ASTM D790
Elongation	0.3% min.	ASTM D638
Strain at Break	0.8% min.	ASTM D638
Hardness	90-Rockwell "M" scale 52-Barcol Impressor min.	ASTM D758
Thermal Expansion	3.5×10^{-6} in/in/deg C max 1.95×10^{-6} in/in/deg F max	ASTM D696
Color Stability	No change, min. 100 hours	NEMA LD3-3.10
Wear and Cleanability	Passes	ANSI Z124.3
Abrasion Resistance	No loss of pattern Weight loss (1000 cycles)=0.9 g. max.	NEMA LD3-3.01 ANSI Z124.3
Boiling water Surface Resistance	No Change	NEMA LD3-3.05
High Temperature Resistance	No Change	NEMA LD3-3.06
Conductive Heat Resistance	No Change	NEMA LD3-3.08
Impact Resistance		
Notched Izod	0.24 ft.-lbs./in. of notch min.	ASTM D256, Method A
Gardner	9.0 ft-lbs min.	ASTM D3029

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Ball drop		NEMA LD3-303
1/4" sheet	36" min. with 1/2 lb ball, no failure	
1/2" sheet	140" min. with 1/2 lb ball, no failure	
3/4" sheet	200" min. with 1/2 lb ball, no failure	
Stain Resistance	Passes	ANSI Z124.3
Weatherability	No change, min. 1000 hours	ASTM D1499-84
Fungi and Bacteria	No Attack	ASTM G21, ASTM G22
Specific Gravity	1.6 min.	

Water Absorption Weight (% max.)	**24 hrs.**	**Long Term**	ASTM D570
	0.05 (1/4") max. 0.10 (3/4") max.	0.50 (1/4") max. 0.90 (3/4") max.	

Flammability ASTM E84

Solid Colors

	1/4"	**1/2"**	**3/4"**
Flame spread	25 max	25 max	25 max
Smoke Developed	30 max	30 max	30 max
Class	1	1	1

Particulate Patterns

	1/4"	**1/2"**	**3/4"**
Flame spread	25 max	25 max	25 max
Smoke Developed	30 max	30 max	30 max

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Class	1	1	1
Pittsburgh Protocol Toxicity (as used by NY state)	solids-80 grams min. particulate patterns-65 grams min.		"LC50" Test

2.3 ACCESSORY PRODUCTS

A. Joint Adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints by chemical bond.

B. Panel Adhesive: Manufacturer's standard neoprene-based panel adhesive complying with ANSI A136.1-1967, UL listed.

C. Sealant: Manufacturer's standard mildew-resistant, FDA, UL listed silicone sealant in colors matching components.

2.4 FABRICATION

A. Factory fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed Instructions and technical bulletins.

B. Form joints between components using manufacturer's standard joint adhesive; without conspicuous joints. Reinforce with strip of solid polymer material, 2" wide.

C. Rout and finish component edges with clean, sharp returns. Rout cutouts, radii and contours to template. Smooth edges. Repair or reject defective and inaccurate work.

D. Window Stools: 1/2 inch thick solid polymer material, adhesively joined with inconspicuous seams, having round edge, 1" thick minimum and with 1" minimum projection from face of wall, unless otherwise shown on the Drawings.

1. Provide surfaces with a uniform finish, Matte, Gloss range of 5-20. Color to be selected from manufacturer’s Color Group - 1 - 5.

E. Countertops: ½-inch thick solid polymer material, adhesively joined with inconspicuous seams, edge as indicated on the Drawings, unless otherwise indicated.

1. Provide surfaces with a uniform finish, Matte, Gloss range of 5-20. Color to be selected from manufacturer’s Color Group - 1 - 5.

F. Wall Caps: 1-inch thick solid polymer material, adhesively joined with inconspicuous seams, edge as indicated on the Drawings, unless otherwise indicated.

1. Provide surfaces with a uniform finish, Matte, Gloss range of 5-20. Color to be selected from manufacturer’s Color Group - 1 - 5.

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PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Prior to final approval of shop drawings, erect at project site one full size mock-up of each component required, for Architect's review.

B. Should mock-up not be approved, re-fabricate and reinstall until approval is secured. Remove rejected units from project site.

C. Approved mock-ups may remain as part of finished work.

3.2 FABRICATION

A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings and bath accessories as indicated on Drawings.

B. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.

C. Ensure no blistering, whitening and cracking of components during forming.

D. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings. Backsplashes for most colors may be fabricated by traditional means discussed in K-25294 Backsplashes.

E. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid polymer material is not required when using DuPont™ Joint Adhesive 2.0.

F. Provide holes and cutouts for plumbing accessories as indicated on Drawings.

G. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.

3.3 INSTALLATION

A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.

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C. Perform installation in accordance 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 the work.

D. Install countertops with no more than 1/8" sag, bow or other variation from a straight line.

E. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Completion of the Work.

F. Coordinate connections of plumbing fixtures with Plumbing Work Specification on the Plumbing Work specification on the Plumbing Work specification on the Drawings.

3.4 CLEANING

A. Clean shop finished surfaces, touch-up as required, and remove or refinish damaged or soiled areas, as acceptable to Architect.

3.5 PROTECTION

A. Contractor to take all precautions as recommended by the manufacturer for protection of installed solid plastic products from damage by work of other Trades.

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SECTION 07200 - BUILDING INSULATION

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 DESCRIPTION OF WORK

A. Work included in this Contract: Contractor shall include all labor, materials, services, installation, equipment, etc., necessary to complete all building insulation (except roof insulation) to achieve complete and tight building thermal barrier to prevent the passage of exterior air into conditioned spaces and prohibit the formation of condensation.

1. Provide indicated types of insulation as shown on Drawings, as specified herein, and/or as required by all job conditions and building assemblies, whether clearly shown or not to achieve included work.

2. Insulation types include but are not limited to the following:
   a. Fire safing insulation with UL approved coating.

3. Related Work:
   a. Section 04200 - Unit Masonry,
   b. Section 07840 - Through-Penetration Firestop Systems,
   c. Section 09250 - Gypsum Drywall.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to Authorities Having Jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.

2. Fire-Resistance Ratings: ASTM E 119.

3. Combustion Characteristics: ASTM E 136.

B. Fire and Insurance Ratings: Comply with fire-resistance, flammability and insurance ratings indicated, and comply with governing regulations as interpreted by authorities.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of insulation required. Include data substantiating that materials comply with specified requirements.

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B. Samples: Submit triplicate samples of the following listed items, in accordance with Bid Documents. Obtain Architect's approval before proceeding with ordering or fabrication of items of this section:

1. Each type of insulation specified - 12 inches square.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General Protection and Handling: Protection from Deterioration: Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Fire Safing Insulation:
   a. Industrial Insulation Group, LLC
   b. Fibrex Insulations.
   c. Isolatek International.
   d. Owens Corning.
   e. Or approved equal.

B. Mineral-Wool Board Insulation:

1. Semi-Refractory Fiber Board Fire Safing Insulation: Semi-rigid boards designed for use as a fire stop at openings between edge of slab and exterior wall panels, at top of masonry and wallboard walls/deck interface, and shall be produced by combining semi-refractory mineral fiber manufactured from slag with thermosetting resin binders.

2. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with a flame-spread index of 15 and a smoke-developed index of zero, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   a. Nominal density of 4 lb/cu. ft., Types IA and IB, thermal resistivity of 4°F x h x sq. ft./Btu x in. at 75°F.

3. At all rated masonry and wallboard walls and partitions, the fire safing insulation shall be coated with 3M Firedam products; or approved equal, to achieve indicated UL design requirements.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

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B. Fire Safing Insulation

1. Install fire safing insulation at all indicated locations, as required by Authorities Having Jurisdiction and in accordance with manufacturer's instructions.

2. Provide sealant material and type required for indicated applications. Provide fire rated type at rated assemblies.

3. Provide coating materials at indicated UL rated assemblies.

C. All installations of insulation and work of this section shall meet approval of Architect and all code Authorities Having Jurisdiction at no additional cost to the Owner.

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SECTION 07900 - JOINT SEALER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Part 1 through Part 6 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes joint sealant assemblies for the following applications which include performances of materials, installation requirements, as indicated herein in this Specification and as specified by cross references in other Parts 1 through 6 Specification sections.

B. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:

1. Perimeter joints between exterior masonry wall materials and frames of louvers, plumbing vents, as applicable.

2. Other joints, as indicated.

C. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:

1. Perimeter joints of exterior openings, where indicated.

2. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
   a. Perimeter joints between interior wall surfaces and frames of interior doors.
   b. Joints between plumbing fixtures and adjoining walls, floors and counters.
   c. Other joints, as indicated.

3. Interior joints in the following horizontal traffic surfaces:
   a. Control and expansion joints in cast-in-place concrete slabs.
   b. Other joints, as indicated.

D. Preparation of all joints to be sealed.

E. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:

1. Cutting out as needed to give proper depth.

2. Installation of proper back up material for each joint.

3. Cleaning to remove all dust, dirt, oil films, loose material etc.

4. Masking of adjacent surfaces.

5. Priming of joint surfaces.

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1.3 QUALITY ASSURANCE

A. Fire Performance Characteristics: Where fire rated joint assemblies are indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with the following requirements, tested by a recognized testing and inspecting organization or by another means, as acceptable to Authority Having Jurisdiction.

1. Fire Testing: ASTM E 119/UL 263.

2. Surface Burning Characteristics: ASTM E84/UL 723.
   a. Flame Spread: 15
   b. Smoke Developed: 0

3. Through - Penetration Firestopping: ASTM E814/UL 1479.

4. Fire Resistance of Building Joint Systems: UL 2079

B. VOC Content of Interior Sealants and Sealant Primers: Comply with the following limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: Not more than 250 g/L.

2. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.

3. Sealant Primers for Porous Substrates: Not more than 775 g/L.

C. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint sealant installations with a record of successful in-service performance.

1. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

2. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   a. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   b. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
   c. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:
      (1) Locate test joints where indicated or, if not indicated, as directed by Architect.
      (2) Conduct field tests for each application indicated below:
         (a) Each type of elastomeric sealant and joint substrate indicated.
         (b) Each type of nonelastomeric sealant and joint substrate indicated.

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(3) Notify Architect seven days in advance of dates and times when test joints will be erected.
(4) Sealant Manufacturer Responsibility:
(a) Manufacturer shall provide Technical Representative to perform Sealant Joint Field Pull Test. Manufacturer Sales representative is not acceptable to perform Field Pull Test.
(b) Technical Representative performing Field Pull Test must be an employee of the Sealant Manufacturer. Outside Sales Agent or Contract Technical Representative is not acceptable to perform Field Pull Test.
(5) Test Method: Test joint sealants by hand-pull method described below:
(a) Install joint sealants in 60-inch long joints using same materials and methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.
(b) Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
(c) Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
(d) For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
(6) Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
(7) Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

3. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
a. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
b. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

4. PROJECT CONDITIONS
a. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
(1) When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
(2) When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40°F.
(3) When joint substrates are wet.

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b. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
c. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

D. Special Project Warrantee and Guarantee:

1. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   a. Warranty Period: **Five (5) years** from approved date of Substantial Completion.

2. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   a. Warranty Period: **Five (5) years** from approved date of Substantial Completion.

3. Guarantee shall further state that all exterior sealant will be guaranteed against:
   a. Adhesive or cohesive failure in joints where movement is under maximum 25% extension or compression.
   b. Any crazing greater than 3 mils in depth developing on surface of material.

1.4 SUBMITTALS

A. Product Data from manufacturers for each joint sealer product required, including instructions for joint preparation and joint sealer application, include color samples showing full range of colors available, for each product exposed to view.

1. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

B. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:

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1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturers.

2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40°F (4.4°C).

3. When joint substrates are wet due to rain, frost, condensation or other causes.

B. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by joint sealer manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealers indicated or, if not otherwise indicated, as selected by Architect from manufacturer's available full range of standard and optional colors.

C. Grade of Sealant: For each application, provide the grade of sealant (nonsag, self-leveling, no track, knife grade, etc.) as recommended by the manufacturer for the particular condition of installation (location, joint shape, ambient temperature, and similar conditions) to achieve the best possible overall performance. Grades specified herein are for normal condition of installation.

2.2 MISCELLANEOUS MATERIALS

A. Joint Primer/Sealer: Provide the type of joint primer/sealer recommended by the sealant manufacturer of the joint surfaces to be primed or sealed.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Sealant Backer Rod: Provide materials which are in compliance with ASTM D 1056; compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam. butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer.

1. Materials shall be capable of remaining resilient at temperatures down to minus 26°F.

D. Joint Fillers:

1. Joint Fillers for Interior Concrete Slabs: Provide “Ceramar” flexible foam expansion

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joint, as manufactured by W.R. Meadows, Inc.; or approved equal.

a. Flexible foam expansion joint filler composed of a unique synthetic foam of isomeric polymers in a very small, closed-cell structure. Gray in color, Ceramar; or approved equal, is a lightweight, flexible, highly resilient material offering recovery qualities of over 99%. The compact, closed-cell structure will absorb almost no water.
b. Non-impregnated and will not stain or bleed.
c. Non-gassing.
d. Complies with:
   (1) ASTM D 5249, Type 2,
   (2) ASTM D 1752, Sections 5.1 - 5.4, with compression requirement modified to 10 psi minimum and 25 psi maximum,
   (3) ASTM D 7174-05.

2.3 SEALANTS

A. **Sealant Type 1**: For all control and expansion joints in concrete slabs on grade, two-part, self leveling polyurethane traffic grade sealant, complying with, and ASTM C 920 and ASTM D 1850.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "NR-200 Urexpan"; Pecora Corporation.
   b. “THC 900/901"; Tremco, an RPM Co.
   c. “Sikaflex-2c SL”; Sika Corporation.
   d. Or approved equal.

2. Color to be selected by the Architect.

B. **Sealant Type 2**: For sealing exterior joints, provide a Single-Component, Non-sag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. “Spectrum 1 / Spectrum 800"; Tremco, an RPM Co.
   b. “SikaSil - WS290"; Sika Corporation
   c. “Dowsil 790 Silicone Building Sealant; Dow Corning Corporation
   d. Or approved equal.

C. **Sealant Type 3:** For all interior joints, provide a one-part, non-sag, moisture-curing polyurethane rubber sealant, complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, A, O and as recommended by manufacturer for general use as an interior exposed building construction conditions sealant including floor tiles in Toilets - Section 09300.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. “Dynatrol I-XL”; Pecora Corporation.
   b. “Dymonic or Dymonic FC for cold weather”; Tremco, an RPM Co.
   c. “Chem-Calk 900 /915/945"; Bostik Inc.
   d. “Sikaflex 1a or Sikaflex 15LM”; Sika Corporation.
   e. Or approved equal.

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D. **Sealant Type 4:** For all joints at plumbing fixtures, provide one-part, neutral-curing, silicone rubber sanitary sealant, complying with ASTM C920; and containing fungicide for mildew resistance recommended by manufacturer for use at joints for plumbing fixtures; sinks, countertops, appliances, etc.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. "898 Silicone"; Pecora Corporation.
   b. "Tremsil 200"; Tremco, an RPM Co.
   c. "786 Mildew Resistant"; Dow Corning.
   d. "Sikasil N-Plus"; Sika Corporation.
   e. Or approved equal.

E. **Sealant Type 5**: For all interior joints between drywall partitions, CMU walls, hollow metal framing, cabinet heater, other metal mechanical or electrical assemblies, (sealant work performed by other Trades and cross-referenced to the work of this section), etc., where all adjacent surfaces will receive paint:

1. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant recommended for exposed joints applications, complying with ASTM C 834, Type P (opaque sealants), Grade NF.

2. Products: Subject to compliance with requirements, provide one of the following:
   a. "AC-20 Plus Silicone"; Pecora Corporation.
   b. "Tremflex 834"; Tremco, an RPM Co.
   c. "Sonolastic Sonolac"; Sonneborn Building Products Div., ChemRex, Inc.
   d. Or approved equal.

F. **Sealant Type 6: Hybrid Sealants (Silyl-Terminated Polyether (STPE) Joint Sealants**

1. **STPE, S, NS, 50, NT**: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyether joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   a. Uses: Interior and exterior horizontal and vertical joints of door and window perimeters, expansion and control joints, coping and coping to facade joints, EIFS and architectural panels, fiber cement panels, etc.
   b. Products: Subject to compliance with requirements, provide one of the following:
      1) "DynaTrol® I-XL Hybrid" as manufactured by Pecora Corporation. Available in ten (10) colors.
      2) "DynaTrol® I-XL Hybrid FTH" as manufactured by Pecora Corporation. Field tintable, available in fifty (50) colors.
      3) Equivalent by Tremco, an RPM Co.
      4) Equivalent by Sika.
      5) Equivalent by Dow Corning.
      6) Or approved equal.

2.4 FIRE RATED JOINTS

A. Construction fire rated joint assemblies shall meet indicated fire rating performance requirements. Provide assemblies where required and as indicated on the Drawings with the following components:

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1. Joint Filler: Subject to compliance with indicated requirements, provide one of the following:
   a. "Ultra Block", as manufactured by Backer Rod Manufacturing,
   b. "Cerablanket"; Tremco,
   c. ThermaFiber
   d. Or approved equal.

   Note: Provide fire rated joint filler in thickness and shape as required to fill joints.

2. Joint Sealant: Subject to compliance with requirements, provide one of the following:
   a. "Dynatrol II"; Pecora Corporation.
   b. “Tremstop Acrylic”; Tremco, Inc, or “Trimstop IA, Intumescent Acrylic, Tremco, Inc.
   c. “Sikaflex-2c NS”; Sika Corporation.
   d. Equivalent by Dow Corning.
   e. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealers, with Installer present, compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:

B. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellants; water; surface dirt; and frost.

C. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

D. Remove laitance and form release agents from concrete.

E. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile; and other nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

F. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer substrate tests or prior experience. Apply

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primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.

G. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

H. Install joint fillers of type indicated 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 which allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint fillers.

2. Do not stretch, twist, puncture, or tear joint fillers.

3. Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material.

I. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.

J. Install compressible seals serving as sealant backings to comply with requirements indicated above for joint fillers.

K. Installation of Sealants: 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 widths which allow optimum sealant movement capability.

3.3 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

END OF SECTION 07900

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SECTION 08110 - HOLLOW METALWORK

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 DESCRIPTION OF WORK

A. Extent of hollow metalwork for frames and borrow lite(s) is indicated and scheduled on Drawings.

B. Related Sections:

1. Section 04200 - Masonry Work.
2. Section 07900 - Joint Sealer Assemblies.
3. Section 08211 - Wood Doors.
4. Section 08700 - Finish Hardware.
5. Section 08800 - Glass & Glazing.
6. Section 09250 - Gypsum Drywall.
7. Section 09900 - Painting.

1.3 QUALITY ASSURANCE

A. Provide frames complying with the following:

1. Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

2. American National Standard Institute:
   a. ANSI Standards A156 Series for Hardware.
   b. ANSI A115 Steel Door Preparation Standards.

B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated frame assemblies that have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests of Door Assemblies" by a nationally recognized independent testing and inspection agency acceptable to Authorities Having Jurisdiction, (i.e., UL., Warnock Hersey).

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data substantiating that products comply with requirements.

B. Shop Drawings: Submit for fabrication and installation of steel frames. Include details of each frame type, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

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1. Provide schedule of frames using same reference numbers for details and openings as those on Contract Drawings.

C. Samples: Full range of color samples for Architect selection; 2 samples, 6" square min., of each color and texture as selected for factory-finished frames.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Before shipping, label each frame with metal or plastic tags to show its location, size, wood door swing, and other pertinent information. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.

B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store frames at building site under cover. Place units on minimum 4" high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering steel frames which may be incorporated in the work include; but are not limited to, the following:

1. Steelcraft, a Division of Allegion.
2. Republic Doors and Frames, a Division of Allegion.
3. Ceco Door Products, a Division of Assa Abloy.
4. Curries Company, a Division of Assa Abloy.
5. Or approved equal.

B. **Substitutions: Substitution of products will only be considered when the Contractor / Door Supplier have submitted, to the Architect, all appropriate documents and in the time frame as outlined in the requirements indicated in AIA A232 and Section 00800.**

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A1008 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18-gauge galvanized sheet steel.

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E. Inserts, Bolts, and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Shop Applied Paint:

1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, capable of passing a 100 hours salt spray and 250 hours humidity test in accordance with ASTM test methods B 117 and D 3322 and shall be suitable as a base for specified finish paints indicated in Specification section 09900.

2.3 ACCESSORIES

A. Inserts: For required anchorage into concrete work, furnish inserts of cast iron, malleable iron or 12 gauge steel hot-dip galvanized after fabrication.

B. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled in, expansion bolt anchors.

2.4 FABRICATION, GENERAL

A. Fabricate frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site.

B. Fabricate frames, concealed stiffeners, reinforcement, edge channels, from either cold-rolled or hot-rolled steel (at fabricator's option).

C. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

D. Finish Hardware Preparation: Prepare frames to receive finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series Specifications for door and frame preparation for hardware.

E. Reinforce frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

F. Locate finish hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.

2.5 STANDARD STEEL FRAMES

A. Provide metal frames for wood doors and borrowed lights of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated.

1. Fabricate frames of minimum 16-gauge cold-rolled furniture steel at interior locations.
   a. Frames for 90 minute fire-rated doors in Corridors shall be 14-gauge cold-rolled furniture steel.

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2. Fabricate frames with mitered and (face welded / full profile welded).

B. Hardware reinforcing shall be as follows:

1. All frames are to be mortised reinforced, drilled and tapped in factory for all template mortise hardware, in accordance with "Approved" Finish Hardware Schedule and templates as provided by the Hardware Supplier. Where surface mounted hardware is to be applied, all frames shall have reinforcing plates.

2. Reinforcement plates shall be as follows:
   a. Hinge Preps:
      1) Masonry: For "F" Series: 7 gauge, minimum.
      2) Metal Stud/Drywall: For "DW" Series: 7 gauge, minimum.
   b. Strike Preps:
      1) Masonry: For "F" Series: 12 gauge, minimum.
      2) Metal Stud/Drywall: For "DW" Series: 12 gauge, minimum.
   c. Closure Reinforcement: All Series - 12 gauge, minimum.
   d. Surface mounted hardware: All Series - 12 gauge, minimum.

3. Base anchors for frames to be installed in masonry and drywall wall and partition assemblies, shall be adjustable type, shipped loose and to be 14 gauge, minimum.

4. Jamb Anchors:
   a. For "F" Series frames in masonry walls provide adjustable wire type anchors (0.156" dia.), or strap type anchors (16 gauge), and "DW" Series frames in metal stud / drywall walls field adjustable compression anchors, provide quantities as follows:
      1) Frames up to 7'-6" in height: 3 per jamb.
      2) and one (1) adjustable base anchor per jamb.

5. Reinforce heads and jambs where indicated on Drawings with 10 gauge channel, continuously welded to frame.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install standard steel frames and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

C. **Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position so that the head and jambs of the frame are square, plumb, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.**

D. In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels.

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E. Install fire-rated frames in accordance with NFPA Std. No. 80.

F. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels, or as indicated. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws. Use indicated anchors and as per manufacturer's recommendations.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Check and re-adjust operating Finish Hardware items, without causing any damage to frames. Provide complete work for frames, leave clean and in proper operating conditions.

END OF SECTION 08110

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SECTION 08211 - WOOD DOORS

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.

B. Related Sections:

1. Section 01800 - Time of Completion and Liquidated Damages
2. Section 04200 - Unit Masonry
3. Section 08110 - Hollow Metalwork
4. Section 08700 - Finish Hardware
5. Section 08800 - Glass and Glazing
6. Section 09900 - Field Painting of metal lites

1.2 SUMMARY

A. Extent and location of each type of flush wood door is indicated on Drawings and in the door schedule.

B. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive plained before veneering. Assembly of face veneer and crossband to core in accordance with WDMA.

1. Structural Composite Lumber (SCL) with wood edge: Compatible species as face veneer.
2. Solid core 20 min. labeled flush Structural Composite Lumber (SCL) with wood edge: Compatible species as face veneer.
3. Mineral core 45, 60, and 90 min. labeled flush wood doors with wood edge: Compatible species as face veneer.

C. Shop-priming of wood doors is included in this Section.

D. Factory-finishing of wood doors is included in this Section.

E. Factory-prefitting to frames and factory-premachining for hardware for wood doors is included in this Section.

1.3 QUALITY ASSURANCE

A. Construction per WDMA I.S. 1A - 11.

B. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per ASTM 2074-00 Fire Test (Category A Positive Pressure). For mineral core doors, provide composite blocking with improved screw holding capability as needed to eliminate through-bolting of hardware. They are to be labeled and listed for ratings indicated by UL, Warnock Hersey or other testing and inspection agency acceptable to Authorities Having Jurisdiction. Fire labels shall be affixed

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at the factory of the door manufacturer, and shall be from the Underwriter's or Warnock Hersey Testing Laboratories. Each label shall show the testing time of the label, and no approval will be given to "Construction Type" labels.

1. All “Category A” doors shall have concealed intumescent seals.

C. Door Construction Field Examination: Upon direction of the Architect, the Contractor may be instructed to destroy a randomly selected wood door or panel by sawing it in half, vertically and horizontally, to verify conformance of the contract requirements. If the door(s) do not meet the Specifications, all of the doors delivered for the project will be rejected, and the doors shall be replaced at the Contractor's expense. Further door inspection, to insure conformity to Specifications, shall also be at the expense of the Contractor.

1. All such delays as a result of the fabrication and delivery of non-compliant doors which vary from the processed shop drawing submittal will be the responsibility of the Contractor (refer to Section 01800 for Liquidated Damages).

1.4 REFERENCE STANDARDS

A. Comply with the applicable requirements of the following standards unless otherwise indicated.

1. Window & Door Manufacturers Association (WDMA)
   a. I.S. 1A - 11 Architectural Wood Flush Doors (WDMA).
   b. Standard Procedures and Recommendations for Factory Machining Flush Wood Doors for Hardware.

2. American National Standards Institute
   a. ANSI A115. W Series, Wood Door Hardware Standards.

3. Underwriter's Laboratories, Inc. (UL)
   a. UL 10C Fire Test

4. American Society for Testing and Materials:
   a. ASTM 2074-00 (Category A Positive Pressure) Fire Tests of Door Assemblies.

1.5 SUBMITTALS

A. **The shop drawing submittal will not be reviewed by the Architect unless a complete shop drawing submittal (technical data, details of core and edge construction, location and extent of hardware blocking, fire ratings, factory finish samples, 8" x 10" minimum for finish and 4" x 5" minimum for construction assembly) are made as one complete submittal, by the Contractor, and will be returned to the Contractor if incomplete.**

1. Subsequent delays as a result of an incomplete submittal will be the responsibility of the Contractor (refer to Section 01800 for Liquidated Damages).

B. Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers and factory-finishing Specifications.

1. Include certifications as may be required to show compliance with Specifications.

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2. **The door manufacturer's shop drawing literature which may include language for the substitution of door construction at the option of the manufacturer is not permitted. Doors which are switched will be rejected and all costs associated with the manufacturing of the door type(s) specified will be by the Contractor/Manufacturer.**

C. 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 factory finishing and other pertinent data.

1. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light openings.

D. Samples: Submit samples, 8" x 10" minimum for finish and 4" x 5" minimum for construction assembly, for the following:

1. Doors for Transparent Finish: Flat samples illustrating finish and color of wood grain for each species of veneer and solid hardwood lumber required.

2. Factory-Finished Doors: Each type of factory finish required.

3. Metal Frames for Light Openings: Manufacturers product samples or product cut sheets for light frames and color selector guide for each material and finish required.

E. Warranties and Certification Markings: Furnish with shop drawings:

1. Door supplier must attest, in writing addressed to Architect, that the order has been placed in conformance with specification requirements in all respects.

2. All doors shall carry a "Lifetime" guarantee, including rehang and finish for all door(s) which do not comply with the manufacturer's warranty.
   a. Submit written agreement in door manufacturer's standard form signed by the manufacturer and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup or twist) or which show photographing of construction below its face veneers, or do not conform to tolerance limitations of NWMA.
   b. The warranty shall also include refinishing and reinstallation as may be required due to repair or replacement of defective doors.

3. Copy of Warranty shall be given to the Architect and Owner prior to the completion of the project.

4. All doors shall be factory marked, on the top of the door, showing the order number, item number on the order, size of finished door, material, and core construction, for future information should replacement of the door be necessary.

F. The Wood Door Supplier shall provide a letter indicating all of the following:

1. The wood door supplier has completely reviewed the Bid Documents (Drawings, Specifications and Addenda) and has worked with the distributor in the preparation and submission of a complete shop drawing submittal to the Architect.

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2. The wood door supplier shall attest that the order has been placed in accordance with the Bid Document Drawings, Specifications and Addenda,

3. The wood doors ordered and delivered to the job site are in conformance with the requirements of the job and per the approved shop drawings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations in WDMA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.

B. Protect all doors from damage and moisture under cover. Use wood blocking under horizontally stored doors. At no time will doors be allowed to come in contact with floor or water.

1. The location where the doors are being stored on the job site shall be between 25 - 55% relative humidity. The Contractor shall forward independent certified testing that confirms compliance.

C. All doors not finished at factory must be sealed on all surfaces within one (1) week after arrival at jobsite.

D. Remove all damaged doors from jobsite prior to completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide “Heritage Collection” wood doors as manufactured by VT Industries; or approved equal.

1. Products specified herein have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.

2. Comparable products from other manufacturers will be considered if it can be clearly shown that their products are tested, equal to or will exceed the construction quality requirements, intended performances and all other design attributes listed above and provided that deviations in dimensions and profiles are minor and do not materially detract from the design concept or intended performances as judged solely by the Architect.
   a. Eggers Industries; Architectural Flush Doors Division, a VT Industries company,
   b. “Aspiro™ Series I Marshfield-Algoma™”,
   c. Or approved equal.

3. The use of one manufacturer's catalog numbers, and the specific requirements set forth in Drawings and Specifications are not intended to preclude the use of other manufacturer's products or procedures which may be equivalent, but are given for the purpose of establishing a standard of design and quality for materials, construction and workmanship.

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4. **Substitutions: Substitution of products will only be considered when the Contractor/ Door Supplier have submitted, to the Architect, all appropriate documents and in the time frame as outlined in the requirements indicated in AIA A232 and Section 00800.**

2.2 MATERIALS AND COMPONENTS

A. General: Provide wood doors complying with applicable requirements of referenced standards for kinds and types of doors indicated and as specified.

B. Solid Core Doors for Transparent Finish: Comply with the following requirements:

1. **At existing buildings, provide veneer faces to match the species of the existing veneer or as directed by the Architect.**

2. Aesthetic Grade: Custom, with Grade A faces

3. Species: Match Existing.

4. Cut: Match Existing
   a. Transparent finish; CS-171, Type II.

5. Match between Veneer Leaves: Match Existing.

6. Assembly of Veneer Leaves on Door Faces: Match Existing.

7. Construction: Extra-Heavy Duty Construction, SCLC-5 Bonded (5-ply, with no added urea-formaldehyde glues).

C. Edges

1. Wood edge, compatible species as face veneer.
   a. Manufacturers standard construction with hardwood outer.

D. Core: Structural Composite Lumber Core consisting of an engineered wood product that is made by fusing a network of wood strands together with a water-resistant adhesive to produce a strong, solid and stable product that has true structural properties with excellent screw holding properties and very high split resistance.

1. Core Edge Interface: Vertical and horizontal edges of solid core doors must be securely bonded to the core with waterproof glue containing no added urea formaldehyde resin.

E. Fire-Rated Solid Core Doors

1. Faces and WDMA Grade: Provide species and grade to match non-rated doors in same area of building, unless otherwise indicated.

2. Core Construction
   a. 20 & 45 Min. Doors: Single Leaf - Same Structural Composite Lumber Core as noted above.

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b. 20 & 45 Min. Doors: Double Leaf - Structural Composite Lumber Core which utilizes an engineered hardwood strand board that is oriented and resin bonded to provide physical properties that equal or exceed solid lumber.
c. 60 & 90 Min. Doors: Mineral core composite, tested and approved by the Underwriter's or Warnock Hersey Testing Laboratories, for various levels of fire retardation within a total door assembly.

3. Edge Construction
a. 20 & 45 Min. Doors: Single Leaf - Same Structural Composite Lumber with wood edge, compatible species as face veneer.
b. 20 & 45 Min. Doors: Double Leaf - Stiles to match face veneer, with wood edge, compatible species as face veneer.
1) Manufacturers standard core construction with hardwood outer.
c. 60 & 90 Min. Doors: WDMA Extra Heavy Duty Construction. Stiles and rails to be made of special laminated material matching the face veneer, and tested for the following tests for performance.
1) Split Resistance: Not less than 950 load pounds when tested in accordance with ASTM D 143 test specimen, modified to having a 3/4 inch hole in center.
2) Direct Screw Withdrawal: Not less than 650 load pounds when tested in accordance with ASTM 1037 modified to use a #12 x 1-3/4" steel screw threaded to head with wood threads.
3) Cycle/Slam: 200,000 cycles with no loosening of hinge screws or other visible signs of failure when tested in accordance with requirements of ANSI A 151.1, Section 2.5.
a) Stile Thickness: Hinge stile minimum 5/8". Lock stile minimum 3/4 inch.
b) Rail Thickness: Top: 1/4" (except where required for hardware; reinforcing then to be 5"). Bottom: 1-1/16" minimum.
c) Provide hardware reinforcing as needed and shall be indicated on the shop drawings to the attachment of surface applied hardware without thru bolts.
d. All “Category A” doors shall have concealed intumescent seals.

F. Glazing of Wood Doors:

1. Glazing shall be by the wood door manufacturer.

2. Glass shall be in accordance with requirements of Section 08800.

2.3 LITE FRAMES

A. Metal Lite Frames:

1. Standard Metal Vision Frames:
a. Basis of Design: Model “LoPro™” as manufactured by Anemostat Door Products.
1) Equivalent by National Guard Products, Inc.
2) or approved equal.
b. Material: 20 ga. (1mm) Cold Rolled Steel.
c. Finish: Grey Primer, Beige or Bronze Baked Enamel.
d. Glazing Thickness: Should be 1/4" (6mm), 3/16" (5mm) or 5/16" (8mm) fire and/or safety rated with UL and/or W.H.I classification markings. Nominal glazing

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space of 3/8" (10mm) allows for glazing tape to be used on both sides of the glass.

e. Fire Ratings with UL & W.H.I Classification markings:
   1) 20* Minute: Approved listing at 3204 sq.in. visible lite, max. width 36", max. height 89".
   2) 45/60* Minute: Approved listing at 2772 sq. in. visible lite, max. width 36", max. height 77".
   3) 90* Minute: Approved listing at 1296 sq. in. visible lite, max. width 36", max. height 54".
   4) 3 Hour: Approved listing at 100 sq. in. visible lite, max. width 12", max. height 33".

   Note: *Must be used with fire glazing tape as indicated in Section 08800. Glazing combination must be used in appropriately tested door assembly.

2.4 GENERAL FABRICATION REQUIREMENTS

A. Fabricate wood doors to produce doors complying with following requirements.

B. In sizes indicated for job-site fitting.

C. Factory-prefit and premachine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:

1. Comply with tolerance requirements of WDMA for prefitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.

2. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.

3. Pre-fit and pre-machine wood doors at factory. Machining shall be in accordance with necessary templates supplied by the Builders Hardware supplier, in accordance with the approved Finish Hardware Schedule for this project. Each door shall be machined for all necessary mortise hardware (ie, locks, hinges, closers, etc.) but face or thru bolt holes shall be done in the field, if such machining is not called for on templates, or is not normally machined at factory. No field preparation will be allowed.

4. Sizing of single doors to be undersized for nominal 1/4 inch, with edges beveled on two edges, as required by the frame manufacturer. Pairs of doors will be undersized 3/16 inch to permit no more than 1/8 inch gap between door leaves. Beveling same as single doors. Door edges beveled 1/8 inch in 2 inch thickness of door.

5. Door clearances are to be 1/8 inch at top and the bottom shall be a maximum of 1/2 inch, or as required by job condition or labeling requirements.

D. Metal Astragals: Metal astragals **will not** be accepted, unless otherwise indicated in Section 08700. Pairs of doors shall be equipped with formed steel edges where required for pairs of fire-rated doors.

E. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of doors required.

F. Factory Finish and Uniform Range of Veneers

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1. Prefinish wood doors at factory only.

2. All face veneer shall have uniform range of colors, as specified by Architect, in selection of the range of color of the veneer.

3. Pairs of doors are to have matching grain pattern and color.

4. End match panels or transoms to have a continuous grain pattern and color of door in total door assembly.

5. Comply with recommendations of WDMA for factory finishing of doors, including final sanding, immediately before application of finishing materials.

6. Provide finish WDMA, TR-8, transparent water-based stain and ultraviolet (UV) cured water based polyurethane sealer and topcoat material, color as selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors using finish hardware in accordance with approved hardware schedule. Protect doors from damage until completion of Project. Except where through bolting is required to meet Code for "A" or "B" label doors, install surface applied hardware on metal or wood doors using all thread screws inserted in pilot drilled holes filled with white acrylic glue.

B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's printed instructions and of referenced WDMA standard and indicated in the printed instructions provided by the manufacturer.

C. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.

D. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors.

1. Machine doors for hardware. Seal cut surfaces after fitting and machining.

E. Fitting Clearances for Non-Rated Doors: Provide 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4" clearance from bottom of door to top of threshold.

F. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.

1. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.

2. Bevel fire-rated doors 1/8" in 2" in lock edge; trim stiles and rails only to extent permitted by labeling agency.

3. Prefit Doors: Fit to frames for uniform clearance at each edge.

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G. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at the job site.

H. Manufacturer of wood doors shall install glass in wood doors.

3.2 ADJUSTING AND PROTECTION

A. Operation: Rehang or replace doors which do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

1. Protect doors, as recommended by door manufacturer, to ensure that wood doors will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 08211

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SECTION 08305 - ACCESS DOORS

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. Wall access doors.
2. Fire-rated wall access doors.
3. Ceiling access doors.

B. Types of construction in which access doors are installed include:

1. Masonry.
2. Gypsum board.

C. Exact locations and sizes of access doors may not be indicated on the Drawings. Obtain specific locations and sizes for access doors from trades requiring access to concealed equipment.

D. Products Furnished and Installed under This Section:

1. Installation of anchors for access doors placed in masonry: Division 4.

E. Related Sections:

1. Section 04200 - Unit Masonry.
2. Section 09250 - Gypsum Drywall.
3. Section 09900 - Painting of access doors.
4. General requirements for access doors: Mechanical Work.
5. General requirements for access doors: Electrical Work.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each type of access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.

1. Include complete schedule, including types, general locations, sizes, wall, floor and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.

B. Verification: Obtain specific locations and sizes for required access doors from Trades requiring access to concealed equipment, and indicate on submittal schedule.

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C. Special Size Access Doors: Use where required or requested; indicate on schedule.

D. Shop Drawings: Submit shop drawings for fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

E. Samples: 3" x 5" minimum size, of each panel face material showing factory-finished color and texture.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.; "Building Materials Directory" for rating shown.

1. Attach UL Label on each fire-rated access door.

B. Test Reports: Submit manufacturer's test reports which demonstrate that products comply with required fire ratings.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units which are different than actual opening size necessary for access.

D. Coordination: Furnish inserts and anchoring devices which must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.5 WARRANTY

A. Manufacturer’s standard **five (5) year** warranty against defects in material and workmanship from date of purchase

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering access doors which may be incorporated in the work include, but are not limited to, the following:

1. Bilco Company.
2. J. L. Industries.
3. Milcor/Lima Register.
4. Bar-Co., Inc.
5. Or approved equal.

2.2 MANUFACTURED UNITS

A. Access Door Assembly 2:

1. Location: Wall.
2. Type: Flush door panel with exposed frame.

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3. Substrate: Masonry.
4. Fire rating: 1-1/2 HR (B).
5. Frame: 16 gauge steel.
6. Door: 20 gauge steel flush panel.
7. Hinge: Continuous type hinge with stainless steel pin.
8. Locking device: Keyed cylinder lock.
9. Finish: Baked-on rust-inhibitive prime coat.

B. Access Door Assembly 3:

1. Location: Wall.
2. Type: Flush door panel with exposed frame.
3. Substrate: Masonry.
4. Frame: 16 gauge steel.
5. Doors: 14 gauge steel flush panel.
6. Hinge: Continuous type hinge with stainless steel pin.
7. Locking Device: Keyed cylinder lock.
8. Finish: Baked-on rust-inhibitive prime coat.

C. Access Door Assembly 4:

1. Location: Wall.
2. Type: Flush door panel with concealed frame.
3. Substrate: Gypsum board.
4. Frame: 16 gage steel.
5. Door: 14 gage steel flush panel.
6. Hinge: Double-acting concealed spring hinges allowing door to open a minimum of 165 degrees.
7. Locking device: Keyed cylinder lock.
8. Finish: Baked-on rust-inhibitive prime coat.

D. Access Door Assembly 6:

1. Location: Ceiling.
2. Type: Flush door panel with concealed frame.
3. Substrate: Gypsum board.
4. Frame: 16 gauge steel.
5. Door: 14 gauge steel flush panel.
6. Hinge: Double-acting concealed spring hinges allowing door to open a minimum of 165 degrees.
7. Locking device: Keyed cylinder lock.
8. Finish: Baked-on rust-inhibitive prime coat.

2.3 ACCESSORIES

A. Locking Devices:

1. Where locking devices are indicated, provide one lock per access door.
2. Supply four (4) keys with each lock.
3. Key access door locks alike.

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2.4 MATERIALS AND FABRICATION

A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

C. Frames: Fabricate from 16 gauge steel.

D. Fabricate frame with exposed flange nominal 1" wide around perimeter of frame for units installed in the following construction:

1. Exposed masonry.
2. Drywall finish.

E. For gypsum drywall, furnish perforated frames with drywall bead.

F. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

G. Flush Panel Doors: Fabricate from not less than 14 gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees. Finish with manufacturer's factory-applied prime paint.

H. Flush Panel Doors: Fabricate from not less than 14 gauge stainless steel sheet, with concealed spring hinges or concealed piano hinge set to open 175 degrees. Buff exposed surfaces to #4 satin finish.

I. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.

J. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.

K. Provide one cylinder lock per access door. Furnish four (4) keys per lock. Key all locks alike, unless otherwise scheduled.

L. Where shown or scheduled, provide one cylinder lock per access door. Furnish four (4) keys per lock. Key all locks alike, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions for installation of access doors.

B. Coordinate installation with work of other Trades.

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C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

D. Where the Plumbing, Mechanical, or Electrical (MEP) Subcontractor(s) require an access door to be installed to provide access to valves, etc., the MEP Subcontractor shall provide the access door and the General Contractor shall install the access door.

3.2 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION 08305

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SECTION 08700 - 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 16 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 16 "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 A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. 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 Bid 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 08700, 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 ND Series; or approved equal: **Ten (10) years**
        2) Exit Devices
            a) Von Duprin; or approved equal: **Ten (10) years**
        3) Closers
            a) LCN 4050 Series; or approved equal: **Twenty-five (25) years**
        4) Automatic Operators
            a) LCN; or approved equal: **Two (2) years**
    b. Electrical Warranty
        1) Locks
            a) Schlage; or approved equal: **Three (3) years**
        2) Exit Devices
            a) Von Duprin: **Three (3) years**
        3) Closers
            a) LCN: **Two (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 AIA A232 and Section 00800.

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; or approved equal.

2. Acceptable Manufacturers and Products:
   a. Hager BB1191/1279 series; or approved equal.
   b. Best FBB series; or approved equal.

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
   b. Or approved equal.

2. Acceptable Manufacturers:
   a. Select
   b. Roton
   c. Or approved equal.

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,
   b. Or approved equal.

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Or approved equal

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 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Best 9k
   b. Or approved equal

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.

2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
   a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
   b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
   c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
   d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
   e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Lever Design: Rhodes

2.07 DEAD BOLTS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage B500 Series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Falcon D200 Series
   b. Sargent 470 Series

B. Requirements:

1. Provide grade 2 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer's standard strike.
5. Lock Status Indicator Trim: Where specified, provide escutcheon with lock status indicator widow.
   a. Escutcheon height 4.125 inches, width 2.54 inches. Projection 1.32 inches on thumbturn side and 1.28 inches on cylinder side.
   b. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
d. Indicator window to provide 180-degree visibility.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Precision APEX 2000 series
   b. Falcon 24/25 series
   c. Or approved equal

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.

2.09 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 6000 Series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Folger Adam 300 Series
   b. HES 1006 Series
   c. Or approved equal

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with Electrical Subcontractor.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Precision ELR series
   b. Security Door Controls 600 series
   c. Or approved equal

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.

c. Universal 120-240 VAC input.
d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Existing Best Key System
   b. Or approved equal

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.

2.12 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
c. Provide keys with the following features:
    1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
d. Identification:
    1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    2) Identification stamping provisions must be approved by the Architect and Owner.
    3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
e. Quantity: Furnish in the following quantities.
    1) Permanent Control Keys: 3.
    2) Master Keys: 6.
    3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
    4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
    a. Telkee
    b. Or approved equal

2. Acceptable Manufacturers:
    a. HPC
    b. Lund
    c. Or approved equal

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.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4050A series
   b. Or approved equal

2. Acceptable Manufacturers and Products:
   a. Falcon SC70A series
   b. Norton 7500 series
   c. Or approved equal

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.

2.15 ELECTROMECHANICAL CLOSER/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. LCN SEM7800 Series
   b. Or approved equal
   c.

2. Acceptable Manufacturers:
   a. Norton
   b. Rixson
   c. Or approved equal

B. Requirements:

1. Provide single-point or multi-point hold-open electromechanical closer/holders as specified. Coordinate voltage requirements and provide transformer if necessary.

2. Provide closer/holders that function as full rack and pinion door closer when current is interrupted or continuous hold-open is not engaged.
3. Provide door closers with fully hydraulic, full rack and pinion action with high strength cylinder and full complement bearings at shaft.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and 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 backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide 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.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
   b. Or approved equal

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Or approved equal

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.

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson
   b. Or approved equal

2. Acceptable Manufacturers:
   a. Rixson
   b. ABH
   c. Or approved equal

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
   b. Or approved equal

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Or approved equal

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.

2.19 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
   b. Or approved equal

2. Acceptable Manufacturers:
   a. Burns
   b. Trimco
   c. Or approved equal

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.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

B. Scheduled Manufacturer:

1. Zero International
2. Or approved equal

C. Acceptable Manufacturers:

1. National Guard
2. Reese
3. Or approved equal

D. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
   a. Provide non-corrosive fasteners for all exterior applications.
   b. Provide security fasteners where indicated.

2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

E. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction for smoke control ratings indicated based on testing according to UL 1784.

F. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to Authorities Having Jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.

G. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.

H. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.

I. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

J. Automatic Door Bottoms:

1. Provide closed cell sponge, bulb neoprene. or EPDM type of seal as specified in hardware sets.
2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.

K. Rain Drips:

1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
2. Door sweeps or shoes with integral rain drip must meet ADA requirements

L. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.

1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.21 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. LCN
   b. Or approved equal

2. Acceptable Manufacturers:
   a. Rixson
   b. Sargent
   c. Or approved equal

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.

2.22 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives
   b. Or approved equal

2. Acceptable Manufacturers:

a. Burns
b. Rockwood
c. Or approved equal

B. Provide coat hooks as specified.

2.23 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. 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 16, ELECTRICAL and Division 16 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:

1. Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.

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:

1. Apply to head and jamb, forming seal between door and frame.
2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.

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 Bid 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:

Legend:
Link to catalog cut sheet
↯ Electrified Opening

Hardware Group No. CRS-04

For use on Door #(s):
035 034-1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE/OFFICE LOCK W/ INSIDE INDICATOR	ND50HD RHO IS-LOC	626	SCH
1	EA	BEST PERM CORE	TO MATCH EXISTING BEST SYSTEM		BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

Hardware Group No. EXD-1D

For use on Door #(s):
S1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-BE-F-06		626	VON
1	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	THRESHOLD	545A		A	ZER
1	EA	CARD READER	BY SECURITY			BYO
1	EA	DOOR CONTACT	BY SECURITY	↯		BYO
1	EA	POWER SUPPLY	PS902 900-4RL 120/240 VAC	↯	LGR	SCE

Hardware Group No. EXD-1E

For use on Door #(s):
027B-1 027B-2 037A 037B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9827-L-F-2SI-LBR-06-499F	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4050A EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	THRESHOLD	545A	A	ZER

Hardware Group No. EXD-2F

For use on Door #(s):
027A-1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	9827-L-F-2SI-LBR-06-499F	626	VON
1	EA	FIRE EXIT HARDWARE	9827-L-F-2SI-LBRAFL-06-499F	626	VON
2	EA	IC MORTISE CYLINDER - CAM AS REQUIRED	1E74	626	BES
2	EA	RIM CYL THUMBTURN	XB11-979	626	SCH
2	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	GASKETING	328AA-S	AA	ZER

Hardware Group No. EXD-1G

For use on Door #(s):
C001-1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBR-06-499F		626	VON
1	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	FIRE/LIFE WALL MAG	SEM 7800	↯	689	LCN
1	EA	GASKETING	188SBK PSA		BK	ZER
1	SET	GASKETING	328AA-S		AA	ZER

Hardware Group No. EXD-2G

For use on Door #(s):
C002-1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBR-06-499F		626	VON
1	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBRAFL-06-499F		626	VON
2	EA	SURFACE CLOSER	4050A RW/PA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM 7800	↯	689	LCN
1	EA	GASKETING	188SBK PSA		BK	ZER
1	SET	GASKETING	328AA-S		AA	ZER

POSITION

Hardware Group No. OF-01

For use on Door #(s):
036

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE/OFFICE LOCK W/ OUTSIDE INDICATOR	ND50HD RHO OS-OCC	626	SCH
1	EA	BEST PERM CORE	TO MATCH EXISTING BEST SYSTEM		BES
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4050A SPEC ST-5204	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. STO-01

For use on Door #(s):
032 033

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	BEST PERM CORE	TO MATCH EXISTING BEST SYSTEM		BES
1	EA	SURFACE CLOSER	4050A RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. STO-02

For use on Door #(s):
034-2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB358	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	BEST PERM CORE	TO MATCH EXISTING BEST SYSTEM		BES
2	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4050A SPEC ST-5204	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	SET	GASKETING	328AA-S	AA	ZER
1	EA	THRESHOLD	545A	A	ZER
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. TRS-04

For use on Door #(s):
030 031

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	COAT AND HAT HOOK	571	A26D	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION

SECTION 08800 - GLASS AND GLAZING

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.

B. Related Sections:

1. Section 08110 - Hollow Metalwork.
2. Section 08211 - Wood Doors.

1.2 SUMMARY

A. Extent of glass and glazing work is indicated on Drawings and schedules.

B. Types of work or locations requiring glass and glazing include, but are not limited to, glass types scheduled herein and on the Drawings.

1. Doors.
2. Interior borrowed lites.

1.3 QUALITY ASSURANCE

A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

C. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator with a recommended 5 years of successful experience in the production of each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

D. Installer (Glazier): A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program

1. Firm with a recommended 5 years of successful experience in glazing work similar to required work.

E. All glass shall bear the Label of the manufacturer.

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1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including documentation of compliance with requirements and instructions for handling, storing, installing, cleaning and protecting each type of glass and glazing material, and installation and maintenance instructions.

B. Before any glass is delivered to the job site, submit sections and details of glass installation at framing members.

C. Samples: Submit for verification purposes, 12" square samples of each type of glass indicated except for clear single pane units, and 12" long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.

1.6 PROJECT CONDITIONS

A. Examine framing and substrate work to receive glass and glazing materials, and condition under which glass is to be installed. Do not proceed with glazing until unsatisfactory conditions have been corrected.

B. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

1. Install liquid sealants at ambient and substrate temperatures above 40°F.

1.7 WARRANTY

A. Manufacturer’s Limited Warranty on Fire-Rated / Impact Gazing: Written warranty, made out to the Owner and signed by manufacturer, warrants only that the product will be free of manufacturing defects resulting in material obstruction through the glass area and/or edge separation and changes in properties of the interlayer for a period of **five (5) years** from the date of purchase, provided the Products have been properly shipped, stored, handled, installed and maintained.

1. Limitation of Remedy - Inspection: The remedy for product proved to be defective under the terms of this warranty is limited to shipment of replacement product. With respect to all claims under this warranty, the Manufacturer shall have the right to inspect any and all products alleged to be defective.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include; but are not limited to, the following:

1. Fire Rated Glass Assemblies:
   a. Pyran® Platinum F by Schott Glass Products.
   b. Or approved equal.

2.2 FIRE-RATED / IMPACT GLAZING AND FRAMING ASSEMBLIES

A. Fire protection rated and impact safety rated glazing material with a thickness (indicated below), made from a patented directional specialty tempered glazing or laminated glass ceramic with a transparent appearance.

1. Units are tested listed and labeled by Underwriters Laboratories Inc., UL, for the following applications and comply with the following Agencies:
   a. Classified and labeled by Underwriters Laboratories, Inc.®. Test report number for labeled fire-rated assemblies is UL File No. R22036.
   b. All above tests performed in accordance with UL 9, UL 10B, UL 10C, NFPA 257, NFPA 80, ASTM E2010-01, ASTM E2074-00.
   c. This product is not considered a barrier to radiant heat and has not met the ASTM E-119 or UL 263 test standards.
   d. Fire rated for up to 90 minutes with required hose-stream test.
   e. Fire-rated for up to 180 minutes in doors with required hose-stream test.
   f. Withstands thermal shock.

3. Impact rating: ANSI Z97.1 (Class A) and CPSC 16CFR1201 (Cat. I and II).

4. Passes positive pressure test standard UL 10C.

5. Laminated floated glass-ceramic.

6. Clear and colorless without the distracting amber tint associated with competitive glass-ceramics. Microfloat process allows for smooth surface and distortion-free mirror finish.

7. Approved for use with any fire-rated frame.

8. Sound Transmission Class (STC): 36

9. The panel must be placed on calcium silicate or hardwood setting blocks and glazed using PYRAN® Platinum classified glazing tape, such as closed cell PVC, Fiberfrax tape or Pemko FG3000S90; or approved equal.

B. Subject to compliance with requirements, provide fire-rated impact glazing, as follows:

1. FRIG-1: Fire-Rated / Impact Gazing - Provide Pyran® Platinum F (filmed) by Schott Glass Products; or approved equal.

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a. Doors with fire rating requirements of up to 90 minutes.
   1) Doors, Non-Temperature Rise - Maximum exposed area of glazing = 3,708 sq. in.
      a) Maximum: Width = 37-3/4" & Height = 94-1/4".
   2) Thickness: 3/16"
   3) Provide 5/8" glazing stops.

b. Doors, Temperature Rise and Non-Temperature Rise of up to 180 minutes.
   1) Maximum exposed area of glazing = 100 sq. in.
      a) Maximum: Width = 12" & Height = 33".
   2) Thickness: 3/16"
   3) Provide 5/8" glazing stops.

c. Other than Doors with fire rating requirements of up to 90 minutes.
   1) Maximum exposed area of glazing = 4,933 sq. in.
      a) Maximum: Width = 98-1/4" & Height = 98-1/4".
   2) Thickness: 3/16"
   3) Provide 5/8" glazing stops.

2.3 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by manufacturer.

1. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
   a. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.4 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

B Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

C. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

D. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

E. Compressible Filler Rods: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.2 STANDARDS AND PERFORMANCE

A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.

B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.

C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Inspect each piece of glass immediately before installation, and discard pieces which have significant edge damage or face imperfections.

F. Unify appearance of each series of lites by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other piece.

3.3 PREPARATION FOR GLAZING

A. Clean glazing channel and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

B. Apply primer or sealer to joint surfaces where recommended by sealant manufacturer.

3.4 GLAZING

A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.

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B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.

D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.

I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.5 PROTECTION AND CLEANING

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

B. Protect glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Maintain glass in a reasonably clean condition during construction, so that it will not be damaged by corrosive action and will not contribute (by wash-off) to deterioration of glazing materials and other work. Comply with manufacturer's instructions.

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E. Wash and polish glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Comply with glass manufacturer's recommendations for final cleaning.

END OF SECTION 08800

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SECTION 09250 - GYPSUM DRYWALL

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. Extent of each type of gypsum drywall construction required is indicated on the Drawings.

B. This Section includes the following types of gypsum board construction:

1. Gypsum drywall including screw-type metal support system
2. Impact resistance gypsum wallboard
3. Water-resistant gypsum wallboard
4. Sound Insulation
5. Drywall finishing (joint tape and compound treatment)
6. Vinyl trim and accessories.
7. Knee Wall Brace Kit.

C. Related Section(s):

1. Section 09657 - Commercial Smooth Sheet Vinyl
2. Section 09900 - Painting

1.3 QUALITY ASSURANCE

A. Manufacturer: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

B. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to Authorities Having Jurisdiction.

1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listing of other testing and agencies acceptable to Authorities Having Jurisdiction.

C. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

D. Fireblocking and Draftstopping: Comply with the International Building Code requirements for installation of fireblocking and / or draftstopping, to prevent the fire passage of flame and product of combustion through concealed spaces or openings in gypsum board systems, in the event of fire.

E. Provide self extinguishing vinyl trim accessories which do not support combustion once flame source is removed.

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1.4 REFERENCES

A. ANSI/ASTM C 840 Gypsum Board Standard - Comply with applicable requirements for application and finishing of gypsum board, unless otherwise indicated.

B. ASTM C1396/C1396M Gypsum Wallboard (Standard, Type X, Flexible, Ceiling, Foil-Backed, Mold-Resistant)

C. ASTM C1178/C1178M Standard for Glass Mat Water-Resistant Gypsum Backing Panel

D. ASTM C754 Steel Framing Standard - Comply with applicable requirements for installation of steel framing for gypsum board)

E. ASTM C11 Gypsum and Related Building Materials and Systems

F. ASTM C1396/C1396M Impact Resistance Gypsum Wallboard and tested in accordance with ASTM C1629/C1629M

G. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPCV) Compounds

H. ASTM C475/C475M Joint Treatment Materials

I. ASTM D3678 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior-Profile Extrusions

J. ASTM C1047 Interior Trim

K. Application and Finishing of Gypsum Panel Products: GA-216

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product Specifications and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these Specifications.

1. Provide product data for impact resistance gypsum wallboard system.

B. Shop drawings: Submit shop drawings for wall metal stud framing for structural heavy gauge wall studs supporting other equipment, items, cabinets, etc.

1. Show layout, spacings, sizes, thicknesses, and types of metal framing, fabrication, fastening and anchorage details, including mechanical fasteners.

2. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of Work.

3. Indicate manufacturer’s design thickness to meet structural performance requirements for each wall mounted item, equipment, cabinet, etc.

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C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS

A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

1. Minimum Room Temperatures: When ambient outdoor temperatures are below 55°F maintain continuous, comfortable building working temperature of not less than 55°F for 48 hours prior to application and continuously thereafter until drying is complete.

2. Ventilate building spaces as required to remove water in excess of that required for drying joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent materials form drying too rapidly.

3. The gypsum drywall shall be installed only when the exterior walls have been erected, permanent roof repairs installed and in watertight condition to prevent the growth of mold. The Contractor shall not install gypsum drywall panels that are wet, have the indication of mold, including but not limited to: fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

B. Metal Support Systems:

1. Allied Structural Industries
2. Clark-Dietrich Building Systems
3. National Gypsum Company
4. Marino\WARE; a Div. of WARE Industries, Inc.

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5. United States Gypsum Co. (USG)
6. Or approved equal.

C. Gypsum Boards and Related Products:

1. CertainTeed Gypsum.
2. Georgia-Pacific Corp.
3. Gold Bond Building Products Div., National Gypsum Co.
4. United States Gypsum Co.
5. Continental Building Products
6. Or approved equal.

D. Impact Resistance Gypsum Wallboard:

1. United States Gypsum Co. (USG)
2. National Gypsum Co.
3. Georgia-Pacific Gypsum, LLC
4. Continental Building Products
5. CertainTeed Gypsum.
6. Or approved equal.

E. Vinyl Trim

1. Trim-Tex,
2. Or approved equal.

2.2 METAL SUPPORT MATERIALS

A. General: Provide components which comply with ASTM C754 for materials and sizes, unless otherwise indicated.

B. Ceiling Support Materials and Systems

1. General: Size ceiling support components to comply with ASTM C754 unless otherwise indicated.

2. Main Runners: Steel channels with rust inhibitive paint finish, hot or cold-rolled.

3. Hanger Wire: ASTM CA641, soft, Class 1 galvanized.

4. Hanger Anchorage Devices: Devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3x calculated load supported.

5. Furring Member: ASTM C645; 0.0179" minimum thickness of base metal, hat-shaped.

6. Furring Anchorages: 16 gauge galvanized wire ties, manufacturer's standard wire type clips, bolts, nails or screws as recommended by furring manufacturer and complying with C754.

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7. Direct Suspension Systems: Manufacturer's standard zinc coated or painted steel system of furring runners, furring tees, and accessories designed for concealed support of gypsum drywall ceilings, of proper type for use intended.

C. Wall/Partition Support Materials

1. Studs ASTM C645, 25 gauge unless otherwise indicated. 20 gauge minimum wherever structural or other gauge studs are called for, for use with impact resistant type gypsum wallboard, and to comply with applicable published instructions and recommendations of gypsum board manufacturer or, if not available, of "Gypsum Construction Handbook" published by United States Gypsum Company.
   a. Depth of Section: 3-5/8 inch, unless indicated otherwise.
   b. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.
   c. Provide structural heavy gauge studs and bracing to support loads of wall mounted items, equipment, cabinets, etc. coordinate with other trades for weight requirements and mounting locations.

2. Hemmed Leg Furring Channel Members: ASTM C645, 25 gauge hat-shaped.

3. Fasteners for Stud Members: Provide fasteners of type, material, size, recommended by furring manufacturer for the substrate and application indicated.

D. Knee Wall Brace Kit

1. Basis of Design: “SKB” Knee Brace Kit as manufactured by Pittcon Softforms® LLC; or approved equal.

2. The welded steel assembly consists of a 2" x 2" steel tube, 1/8" thick wall and a 3½" x 5" x 1/4" thick steel base plate with four (4) holes of 7/16" diameter. The assembly shall be painted with a flat black primer providing a corrosive resistant surface compatible with plaster, joint compounds and interior finishes.
   a. Manufacturer recommends anchoring the base plate using 3/8" x 3½" masonry fasteners with expanded shields for mounting in concrete floor.

2.3 GYPSUM BOARD

A. General: ASTM C1396, in maximum lengths available to minimize end to end joints.

1. Type: Regular, unless otherwise indicated.

2. Edges: Tapered.

3. Thickness: 5/8 inch, unless otherwise indicated.

B. Impact Resistance Gypsum Wallboard: ASTM C1629 level 3 (highest) for hard- and soft-body impact, and tested in accordance with ASTM C473 for moisture and mold resistance and ASTM D3273 for resistance to growth of mold on the surface of interior coatings. Mold Defense per ASTM D3273. Provide Type X; tapered edge, 5/8 inch thick, unless otherwise indicated. (Paintable)

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1. Basis of Design: “Mold Tough VHI Firecode Core” High-Impact-Resistant Panels with Moisture and Mold Resistance; United States Gypsum Co.; or approved equal.

2. Where two layers of gypsum wallboard application is indicated, provide impact resistance type gypsum wallboard only for the exposed to view gypsum wallboard layer.

3. Subject to compliance with requirements of the Contract Documents, manufacturers offering products which may be incorporated in work include the following:
   a. “Hi-Impact XP”, by National Gypsum.
   b. “Extreme Impact Resistant Gypsum Drywall, by CertainTeed Gypsum.
   c. Or approved equal.

2.4 GYPSUM BOARD CEILING SUSPENSION SYSTEM

A. Heavy-Duty Drywall Furring Tee's: Provide heavy-duty furring system which comply with ASTM C645 and has G40 minimum protective for hot -dipped galvanized process and .0179 steel thickness before application of protective coating.

1. Structural Classification: Comply with ASTM C635 for heavy-duty system.

2. Provide manufacturer's standard suspension system accessories required for each condition indicated on the contract documents.

B. The following system indicated, is the "Basis of Design", other manufacturer's will be considered for substitution, provided they comply with the Bid Documents and are submitted as per the requirements of AIA A232 and Section 00800:

1. "Perimeter Solutions"; Armstrong World Industries, Inc.; “Drywall Suspension System”; USG Corp.; or approved equal.

2. Main Beam: Double-web steel construction, hot dipped galvanized, 1-1/2" web height with rectangular top bulb, and prefinished 1-1/2" flange; (Item No. HD8906). For fire rated ceilings provide main beam formed to include integral splice for expansion relief. Web is to be formed to receive override cross tee.

3. Primary Furring Cross Tees: Double-web, hot-dipped galvanized steel, 1-1/2" web height with rectangular bulb and hot-dipped 1-1/2" knurled flange.

4. Secondary Framing Cross Tees: Double-web, hot-dipped galvanized steel, 1-1/2" web height with rectangular bulb and hot-dipped 15/16" flange.

5. Wall Moldings: Manufacturer’s standard hot-dipped galvanized steel angles or channels as selected by the Architect.

6. Hanger Wire: Hot dipped galvanized steel, 12 gauge, tested to exceed 500 lbs. pull out force.

7. Accessories: Manufacturer’s standard angle clips, direct ceiling clips, acoustical transition clips and other accessories required to allow for use of complete grid system at indicated transitions for walls and ceilings.

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2.5 TRIM ACCESSORIES

A. General: Provide manufacturer's standard trim accessories of types indicated for drywall Work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim beads, J-type edge trim beads, special L-kerf type edge trim beads, and one-piece control joint beads.

B. Semi-Finishing Type: Manufacturer's standard trim units which are not to be finished with joint compound (non-beaded), where indicated.

2.6 JOINT TREATMENT MATERIALS (GYPSUM BOARD APPLICATION)

A. General: Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. Joint Tape: Manufacturer's recommended types for indicated applications. Use types compatible with joint compounds.

C. Joint Compounds: Provide manufacturer's recommended types for indicated applications.

1. For interior repair and patching work, provide chemical-hardening-type for bedding and filling, ready-mixed vinyl type or vinyl type powder type for topping.

2.7 MISCELLANEOUS MATERIALS

A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. Gypsum Board Screws: ASTM C954 or ASTM C1002.

C. Acoustical Sealant: Water base type, non-drying, non-bleeding, non-staining type; permanently elastic, as recommended by gypsum board manufacturer.

1. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant, [with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

2. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.8 SOUND ATTENUATION BLANKETS

A. Products shall be in accordance with ASTM C665-84, Type I semi-rigid unfaced mineral fiber blanket, Class 25 flame spread, thickness as indicated, and/or to achieve a minimum of STC 50 rating for indicated assemblies.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION OF METAL SUPPORT SYSTEMS

A. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

1. Furnish concrete inserts and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

3.3 INSTALLATION OF METAL SUPPORT SYSTEMS

A. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

B. Provide furring and shims as required to install new Work over existing substrates so that new Work will be installed plumb. level and true.

C. Ceiling Support Suspension Systems

1. Secure hangers to structural support by anchorage devices or fasteners.

2. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. along runners, except as otherwise shown.

3. Level main runners to a tolerance of 1/4" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.

4. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

5. Direct-hung Metal Support System: Attach perimeter wall track or angle wherever support system meets vertical surfaces. Mechanically join support members to each other and butt-cut to fit into wall track.

6. Space furring member 16" o.c. except as otherwise indicated.

7. Install auxiliary framing at termination of drywall Work, and at openings for light fixtures and similar Work, as required for support of both the drywall construction and other Work indicated for support thereon.

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D. Wall-Partition Support Systems:

1. Install supplementary framing, blocking and bracing at terminations in the Work and for support of fixtures, equipment services, heavy trim, furnishings, and similar Work to comply with details indicated or, if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer or, if not available, of "Gypsum Construction Handbook" published by United States Gypsum Company.

2. Isolate non-load bearing steel stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.
   a. Install single deep-leg deflection tracks and anchor to building structure.
   b. Connect drift clips to cold-formed metal framing and anchor to building structure.

3. Install runners tracks at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other Work, except as otherwise indicated. Ramset to precast plank.

4. Extend partition stud system through acoustical ceilings and elsewhere as indicated to the structural support and substrate above the ceiling.

5. Frame door openings with vertical studs securely attached by screws at each jamb either directly to frames or to jamb anchor clips on door frame; install runner track sections (for jack studs) at head and secure to jamb studs.

6. Space studs 16 inches o.c. except as otherwise indicated.

7. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

8. Frame openings other than door openings in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

9. Provide runner tracks of same gauge as jamb studs. Space jack studs same as partition studs.

10. Cut studs ½" short of full height to provide perimeter relief.

11. Do not fasten studs to top track to allow independent movement of studs and track.

3.4 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL

A. Pre-Installation Conference: Meet at the project site with the installers of related work and review the coordination and sequencing of Work to ensure that everything to be concealed by gypsum drywall has been accomplished, and that chases, access panels, openings, supplementary framing and blocking and similar provisions have been completed.

B. Install sound attenuation blankets at all partitions prior to gypsum board unless readily installed after board has been installed.

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C. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

D. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.

E. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible.

F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

H. Attach gypsum board to framing and blocking provided for additional support at openings and cutouts.

I. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), unless indicated otherwise.

J. Form control joints and expansion joints at locations indicated (@ 30'-0" o.c. or 900 sf), with space between edges of boards, prepared to receive trim accessories.

K. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4 inch to ½ inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

L. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum board over wood framing, with "floating" internal corner construction.

M. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.5 METHODS OF GYPSUM BOARD APPLICATION

A. Single-Layer Application: Install gypsum wallboard as follows:

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.

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3.6 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound. Install "L" type trim where drywall construction is tightly abutted to other construction and install special kerfed type where other work is kerfed to receive long leg of "L" type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).

1. Install J-type semi-finishing trim where indicated, and where exterior gypsum board edges are not covered by applied moldings.

D. Install metal control joint (beaded type) where indicated or required.

3.7 FINISHING OF DRYWALL

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Apply joint compounds in 3 coats (not including prefill of openings in base), and sand between last 2 coats and after last coat.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C11, ASTM C 840 and GA-216:

1. **Level 1**: All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. In plenum areas above the ceiling, attics, areas concealed in the building (does not typically meet fire-resistant assembly requirements.

2. **Level 5**: All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer’s recommendations, applied to the entire surface. The surface shall be free of tool marks and ridges. Finish for areas that are to receive gloss, semi-gloss, enamel or non-textured flat paints.

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3.8 IMPACT RESISTANCE GYPSUM WALLBOARD INSTALLATION

A. General: Install fiber reinforced gypsum wallboard according to manufacturer's instructions and GA-216 "Application and Finishing of Gypsum Board."

1. Nails and Screws: Corrosion resistant; ASTM C 840.

2. Adhesives: Manufacturer’s approved adhesive types.

3. Accessories: Similar to indicated gypsum wallboard application.

4. Joint Tape, Taping Compound and Finishing Compound: Comply with ASTM C 475.

3.9 CLEANING AND PROTECTION

A. Remove temporary coverings used to protect other work.

B. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09250

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SECTION 09510 - ACOUSTICAL CEILINGS

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. Extent of each type of acoustical ceiling is shown and scheduled on the Drawings.

B. Type of acoustical ceilings specified in this section includes the following:

1. Lay in acoustical ceiling board, exposed suspension system.

2. Decorative Ceiling System: Lay-in.

1.3 QUALITY ASSURANCE

A. Installer: Firm with a recommended three years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

B. Fire Resistance Ratings: As indicated by reference to design designation in UL "Fire Resistance Directory" for floor, roof or beam assemblies in which acoustical ceilings function as a fire protective membrane; tested per ASTM E 119. Provide protection materials for lighting fixtures and air ducts to comply with requirements indicated for rated assembly.

C. Surface Burning Characteristics: As follows, tested per ASTM E 84.

1. Flame Spread: 25 or less.

2. Smoke Developed: 50 or less.

D. All acoustical ceilings shall be installed to conform to the requirements of International Building Code for Category C and the recommendation of the Ceiling and Interior Systems Construction Association (CISCA) for Zone 2 seismic design and comply with installation requirements for areas subject to light to moderate seismic activity.

E. General Contractor shall provide adequate ventilation and humidity control before, during and after ceiling installation to prevent damage (sagging, etc.) to ceilings prior to Owner's acceptance of building.

F. Warranty:

1. Provide manufacturer’s special project warranty against sagging or warping of acoustic ceiling boards for a minimum period of **thirty (30) years** which starts on approved date of substantial completion.

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2. Decorative Ceiling Systems:
   a. Provide manufacturer's special project warranty against defects in workmanship, discoloration, or other defects considered undesirable by Architect / Owner for a minimum period of **two (2) years** from date of initial acceptance.

G. Unless otherwise approved by the Architect, all Acoustical Ceiling Board types and Suspended Grid System types shall be by a single manufacturer.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required including certified test reports to show compliance with requirements of these Specifications.

1. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performance.

B. Samples: Submit manufacturer's standard size samples of acoustical units, but not less than 6" square, and of exposed ceiling suspension members including wall and special moldings. Provide samples showing full range of colors, textures and patterns available for each type of component required.

C. Shop Drawings: Submit shop drawings for acoustical ceilings, including layout of system components and details of connections between elements of system and between system and other building components.

1. **Contractor must provide shop drawings certifying that attachment devices meet specified loads. Contractor must coordinate with all other (Sub)Contractors for fixture loads, etc.**

D. Testing Reports: Submit testing reports which indicate compliance with indicated requirements.

E. Deliver extra materials to Owner. Furnish extra materials described below 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% (rounded up to the nearest full carton) of each type of acoustic unit installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0% (rounded up to the nearest full carton) of each type suspension component installed.

1.5 PROJECT CONDITIONS

A. Space Enclosure: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Provide Acoustical Ceiling Board (ACB and AACB) and Metal Suspension System as manufactured by Armstrong World Industries; United States Gypsum Co.; CertainTeed Ceilings; or approved equal.

B. Acoustical Ceiling Tile and Grid system products specified herein have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.

1. Comparable products of the following manufacturers will be considered if it can be clearly shown that their products are equal to or will exceed the construction quality requirements and other design attributes listed as performance of the "Basis of Design" Systems.
   a. USG Corporation,
   b. CertainTeed Ceilings.
   c. Rockfon, LLC,
   d. Or approved equal.

2. The use of one manufacturer's catalog numbers, and the specific requirements set forth in Drawings and Specifications, are not intended to preclude the use of other manufacturer's products or procedures which may be equivalent, but are given for the purpose of establishing a standard of design and quality for materials, construction and workmanship.

C. Substitute products will be considered for substitution only when submitted to the Architect as per the requirements of AIA A232 and Section 00800.

2.2 ACOUSTICAL CEILING BOARDS

A. Refer to reflected ceiling plans for sizes and locations.

B. Where ACB-1 is indicated: 24" x 48" x 7/8" thick, square edge, NRC .80; CAC 35 light reflectance 87%, sag resistance; Humiguard Plus Performance. Armstrong Ultima High NRC (Item# 1943); USG Mars™ High-NRC/High CAC (Item# 86300), equivalent from CertainTeed; or approved equal. [Unperforated]

C. Where AACB is indicated: 24" x 48" x 5/8" thick, square edge, CAC 40; Class A; light reflectance 88%, Sag Resistance; HumiGuard Max Performance, mineral fiber composition with ceramic binders. Armstrong Fine Fissured Ceramaguard (Item# 605), white finish; or approved equal. [Unperforated]

2.3 DECORATIVE CEILING SYSTEMS

A. Refer to Reflected Ceiling Plans for sizes and locations.

B. Where DCS-1 is indicated: Provide "Formations - Acoustical and Accent Clouds Kit with Axiom Vector Trim", as manufactured by Armstrong; or approved equal, size & shapes, as indicated on the Drawings with manufacturer's Prelude XL suspension system, aircraft cable and

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associated hardware for attachment to structure above. Refer to architectural Drawings for spacing and length. Finish as selected by Architect.

1. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
   a. Or approved equal.

C. Perimeter Trim Profiles:

1. "Axiom Trim", as manufactured by Armstrong; or approved equal. Refer to Drawings for sizes and finishes.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated. For exposed suspension members and accessories with painted finish, provide color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's full range of standard colors.

C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung.

D. Concrete Inserts: Inserts formed from hot-dipped galvanized sheet steel and designed for attachment to concrete forms and for embedment in concrete, with holes or loops for attachment at hanger wires.

E. Hanger Wire: Galvanized carbon steel wire, ASTM A 641, soft temper, prestretched, Class 1coating, sized so that stress at 3-times hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12gage (0.106").

F. Type of System: Either direct-hung or indirect-hung suspension system, at Contractor's option.

1. Carrying Channels: 1-1/2 inch steel channels, hot-rolled or cold-rolled, not less than 0.475 lbs. per lineal foot.

G. Edge Moldings and Trim: Metal types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated. Provide 7/8" edge at wall angle and reveal edges.

H. Hold-Down Clips: For interior ceilings composed of lay-in panels weighing less than 1 lb. per sq. ft., or where indicated, provide hold-down clips spaced 2'-0" o.c. on all cross tees.

2.5 EXPOSED METAL SUSPENSION SYSTEMS

A. Double Web Steel Suspension System: For use where ACB ceilings are indicated. Manufacturer's standard system roll-formed from prefinished hot dipped galvanized steel with 15/16" wide exposed faces on flanges of structural members; other characteristics as follows:

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1. Structural Classification: Intermediate-Duty System.

2. Finish: Painted in color as selected by Architect.

3. Basis of Design: Armstrong World Industries “Prelude XL Exposed Tee System”; USG “Donn Brand DX”, CertainTeed 15/16" Classic Stab; or approved equal.

B. Double Web Suspension System: For use where AACB ceilings are indicated. Manufacturer's standard system fabricated from roll-formed prefinished hot dipped galvanized steel with 15/16" wide exposed faces of aluminum cap on flanges of structural members cap and other characteristics as follows:

1. Structural Classification: Intermediate-Duty System.

2. Finish: Painted, in colors as selected from manufacturer's full line of colors. Provide white color unless indicated otherwise.

3. Basis of Design: Armstrong World Industries “Prelude Plus XL Fire Guard”; USG “Donn Brand DXA/DXLA”, CertainTeed 15/16" FireSecure; or approved equal.

2.6 MISCELLANEOUS MATERIALS

A Acoustical Sealant: Resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for interior sealing of concealed construction joints.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine conditions under which acoustical ceiling work is to be performed and notify Architect in writing of unsatisfactory conditions. Do not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner.

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 wherever possible.

3.3 INSTALLATION

A. General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire-resistance rating requirements as indicated, and CISCA standards applicable to work.

B. Arrange acoustical units and orient directionally-patterned units (if any) in manner shown by reflected ceiling plans.

1. Install tile with pattern running in one direction, unless otherwise indicated.

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C. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members. Locate hangers not less than 6" from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0".

1. 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 edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.

1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.

2. Screw-attach moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.

3. Install acoustical panels 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.

4. Install hold-down clips in areas indicated, and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

E. Cooperate with other Trades for installation of their materials and equipment, particularly with those installing the ductwork, ceiling diffusers and lighting fixtures so that diffusers, lighting fixtures and other items are located on center lines of tile or on centers of joints as shown on approved shop drawings.

1. Provide additional hanger wires to support superimposed loads. Locate the supplemental hangers within 6 inches of each corner of the item being supported.

2. Where light fixtures, or other recessed items occur in ceilings, frame acoustical material properly to permit installation of such recessed items and do all necessary cutting and fitting of acoustical materials and suspension systems to accommodate same. Cut neatly around all pipes passing through ceilings. Build in fixture frames and yokes in cooperation with Electrical Subcontractor.

3.4 CLEANING

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, 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. General Contractor is responsible for cleaning or replacement of all damaged tile, regardless of how the damage was caused and regardless of by which Subcontractor.

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SECTION 09650 - RESILIENT FLOORING

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 DESCRIPTION OF WORK

A. Extent of resilient flooring and accessories is shown on Drawings and in schedules.

1. Luxury vinyl tile - (LVT),
2. Rubber resilient wall base.
3. Resilient edge strips.

1.3 RELATED SECTIONS

A. Section 01455 - Concrete In-situ Relative Humidity and pH Testing.

B. Section 02070 - Selective Demolition.

C. Section 03450 - Self-Drying Finishing Underlayment.

D. Section 07900 - Joint Sealer Assemblies.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, Specifications and standards, except where more stringent requirements are shown or specified:

1.	ASTM F 2170-11	Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
2.	ASTM F 1869-11	Standard Test Method Using Anhydrous Calcium Chloride.
3.	ASTM F 710	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
4.	ASTM F 1861	Type TS, Group 1 Performance Requirements for Resilient Rubber Wall Base.
5.	ASTM F 137	Standard Test Method for Flexibility of Resilient Flooring Materials protocol for Resilient Rubber Wall Base.
6.	ASTM F 1515	Standard Test Method for Measuring Light Stability of Resilient Flooring protocols for Resilient Rubber Wall Base.
7.	ASTM D 2240	Not less than 85 Shore A.
8.	ASTM D 3389	Abrasion Resistance: less than 1 gram weight loss.

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9. ASTM D 2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring of 0.6 or greater.

10. ASTM E 648 Standard Test Method for Critical Radiant Flux of 0.45 watts/cm2 or greater, Class I.

B. Moisture vapor emission testing in accordance with ASTM F 1869-11. Test results should not exceed 3 pounds per 1,000 square feet per 24 hours, unless otherwise specified by the flooring or adhesive manufacturer.

1. ASTM Standard also states that relative humidity inside of the concrete slab should not exceed 75%, per ASTM F2170-11, unless otherwise specified by the flooring or adhesive manufacturer.

C. Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

1. Wherever possible, provide each type of required resilient flooring and accessories produced by a single manufacturer.

D. Fire Test Performance: Provide resilient flooring which complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to Authorities Having Jurisdiction.

1. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A, Smoke <450.

2. ASTM E648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class 1.

E. Coefficient of Friction: The Federal and industry standard for testing coefficient of friction or the slip resistance of a surface is tested to the requirements, as outlined, in ASTM D-2047, which utilizes a friction measurement machine, commonly referred to as the James Machine.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of resilient flooring and accessory.

B. Samples for Verification Purposes: Submit the following samples in triplicate of each type, color, and pattern of resilient flooring required, showing full-range of color and pattern variations.

1. Full size tile samples.

2. For initial selection of colors and patterns submit, prior to above, samples in form of actual sections of resilient flooring, including accessories, showing full range of colors and patterns available, for each type of resilient flooring required.

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C. Certification for Fire Test Performance: Submit certification from an independent testing laboratory acceptable to Authorities Having Jurisdiction that resilient flooring complies with fire test performance requirements.

D. Testing of Substrate:

1. Submit test reports of testing the concrete or other floor substrate, indicating compliance with manufacturer's requirements for moisture and alkalinity percentage of contents. Tests shall be performed in accordance with requirements of Section 01455.

E. Maintenance Instructions: Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

F. Replacement Material: After completion of work, deliver to project site replacement materials from same manufactured lot as materials installed, and as follows:

1. Tile flooring, not less than one box for each 50 boxes or fraction thereof, for each type, size and color installed.

1.6 PROJECT CONDITIONS

A. Maintain minimum temperature of 65°F (18°C) or more than 85°F (29°C) in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation.

1. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation.

B. Maintain the ambient relative humidity between 40% and 60% during installation.

C. Install resilient flooring and accessories after other finishing operations, including painting, have been completed.

D. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55°F (13°C) or more than 85°F (29°C).

E. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring manufacturers and their recommendation for bond and maximum levels of moisture and pH per testing as performed under requirements of Section 01455.

1.7 WARRANTY

A. Luxury Vinyl Tile Flooring (LVT)

1. Warranty: Manufacturer's standard for material and labor:
   a. A **fifteen (15) year Limited Commercial Warranty** for labor and material. Warranty period shall start from approved date of substantial completion.

B. Wall Base: **Five (5) year** Limited Commercial warranty.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but not limited to the following:

1. Manufacturers of Luxury Vinyl Tile (LVT):
    a. Basis of Design: CMYK, as manufactured by Patcraft; or approved equal.
        1) Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to the following:
            a) Armstrong Commercial Flooring,
            b) Interface,
            c) Mannington,
            d) Milliken,
            e) Mohawk,
            f) Shaw,
            g) Tarkett,
            h) Or approved equal.

2. Rubber Resilient Wall Base and Accessories:
    a. Pinnacle, as manufactured by Roppe Corporation;
    b. BaseWorks Thermoset Rubber Wall Base, as manufactured by Johnsonite,
    c. RubberMyte, as manufactured by Burke Mercer Flooring Product,
    d. Equivalent by Mohawk,
    e. Or approved equal.

B. Products specified herein have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.

1. The use of one manufacturer's catalog numbers, and the specific requirements set forth in Drawings and Specifications, are not intended to preclude the use of other products by other manufacturer's or which may be equivalent, but are given for the purpose of establishing a standard of design and quality for materials, construction and workmanship.

C. Comparable products of other manufacturers will be considered if it can be clearly shown that their products are equal to or will exceed the construction quality requirements, intended performances and all other design attributes listed above and provided that deviations in dimensions and profiles are minor and do not materially detract from the design concept or intended performances as judged solely by the Architect/Owner.

2.2 LUXURY VINYL TILE FLOORING (LVT)

A. Provide products in compliance with ASTM F 1066, Class 1 as per ASTM E648, through pattern, 12" x 24" plank, with minimum slip resistance as per ASTM D 2047 / UL 410, and as follows:

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1. Asbestos-free.
2. Wear Layer: 20 mil (.020 inches / .5 mm).
3. Overall Thickness: 0.098 inches (2.5 mm).
4. Finish: Exoguard+™
5. Color(s) / Pattern(s): As selected by the Architect from manufacturer's available full range of colors and patterns.
6. Provide manufacturer's approved adhesive.

2.3 ACCESSORIES

A. Wall Base: Provide rubber base complying with ASTM F-1861, Type TS, Group 1. Vulcanized SBR rubber with matching preformed corner units, and as follows:

1. Height: 4-inches, unless otherwise indicated on the Drawings.

2. Thickness: 1/8 inch gauge.

3. Style: Standard top-set cove.

4. Finish / Colors: Matte finishes in colors as selected by Architect from manufacturer's available full range of colors. Allow for more than one color in any given area.

5. Color Stability: Meets or exceeds ASTM F 1861 requirements for color stability when tested to ASTM F 1515 Standard Test Method for Measuring Light Stability of Resilient Flooring protocols.

6. Phthalate, chlorine and halogen free.

B. Resilient Edge Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring, or as selected by Architect from manufacturer's available full range of colors; not less than 1" wide.

C. Adhesives (Cements): Water resistant, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.

1. Adhesives to be used for resilient floor and accessory applications shall not generate any odor or unpleasant smell.

D. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

E. Leveling and Patching Compounds: Latex types as recommended by flooring manufacturer.

2.8 COLORS, TEXTURES AND PATTERNS

A. Colors, textures and patterns shall be as selected and directed by the Architect. Patterns shall be defined as using not more than five (5) different colors of tile in any given area, applied in boarders, stripes, diagonals, checkerboard patterns and other designs as indicated, or if not indicated, shall be as directed by the Architect.

1. All selections shall be made from manufacturer's full product lines, for all products and accessories, (including premium textures and colors).

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PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Inspect substrates and conditions of installation to verify that work may properly commence. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Concrete Substrates: Perform concrete relative humidity and pH testing and to comply with manufacturer's recommended moisture tests before beginning installation, to verify that concrete surfaces have cured sufficiently to allow adhesive bond to resilient flooring.

1. Commencement of work shall constitute acceptance of conditions. Any necessary remedial work required to correct any unsatisfactory conditions, found after the start of installation, will be provided at no cost to the Owner.

3.2 PREPARATION

A. Perform moisture content testing as required by manufacturer’s instructions to ensure pH readings and moisture transmission are acceptable. Perform testing in accordance with requirements of Section 01455.

1. If values exceed this level, follow manufacturer’s recommendations for moisture transmission mitigation. Do not proceed until unsatisfactory conditions have been corrected.

B. Broom clean or vacuum surfaces to be covered, and inspect subfloor.

1. Use leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes and depressions in subfloors.

2. Apply concrete slab primer and/or sealer, as recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3. Remove paint, curing compounds, and other materials that could interfere with adhesion of resilient products.

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.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with manufacturer's published recommendations for installation in each area, extending resilient flooring into spaces which are partially concealed. Cut and fit tightly to fixtures, pipes, and other obstructions, as well as to walls and partitions.

B. Access Covers: Install resilient flooring tightly to removable access covers in field of flooring, taking care that pattern will match when covers are in closed position.

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C. Tightly adhere resilient flooring to substrate with no open joints or cracks, and without raised or blistered areas. Spread adhesive evenly, so that final installation will be without telegraphed markings from adhesive or substrate.

D. Extend resilient flooring into toe spaces, door reveals, and into closets and similar openings.

E. Scribe, cut, and fit resilient flooring to permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions.

F. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.

G. Install resilient flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

H. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

3.4 INSTALLATION OF TILE FLOORS

A. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room area 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.

B. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.

1. Lay tile in pattern shown or as directed by Architect.

C. Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions.

D. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated or where joints occur in substrate. Do not saw cut joints.

3.5 INSTALLATION OF ACCESSORIES

A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.

1. Job-formed Corners:

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a. Outside Corners: Form by bending without producing discoloration (whitening) at bends.
b. Inside Corners: Butt one piece to corner, then scribe next piece to fit.

B. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

C. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.6 CLEANING AND PROTECTION

A. Perform following operations immediately upon completion of resilient flooring:

1. Sweep or vacuum floor thoroughly.

2. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.

3. Damp-mop floor being careful to remove black marks and excessive soil.

4. Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturer.

B. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's directions.

1. Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move stationary equipment or furnishings across floors.

2. Cover resilient flooring with undyed, untreated building paper until inspection for substantial completion.

C. Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Clean resilient flooring by method recommended by resilient flooring manufacturer.

3.7 EXTRA STOCK

A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.

1. Tile Flooring: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern and size selected and installed.

2. Accessories: Furnish not less than 2% of each type, size and color selected and installed.

END OF SECTION 09650

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SECTION 09657 - COMMERCIAL SMOOTH SHEET VINYL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: This section includes labor, materials and other services necessary to complete resilient sheet flooring, slip resistant sheet vinyl flooring systems and accessories work. Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section, including but not limited to the following:
   1. Coordination of start date and timeframe.
   2. Coordination of substrate preparation.
   3. Coordination of moisture and pH testing.
   4. Coordination with moisture mitigation if required.
   5. Coordination of proper plumbing fixtures for connections with flooring.
   6. Floor installation and heat welding of all seams, horizontal and vertical.

B. Related Sections:
   1. Section 01455 – Concrete In-Situ Relative Humidity and pH Testing.
   2. Section 03300 – Concrete Work: Concrete finishing.
   3. Section 04200 – Unit Masonry.
   4. Division 15 – Plumbing Work.

1.2 REFERENCES

A. **ASTM D 2047**, Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.

B. **ASTM E662**, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

C. **ASTM F710**, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

D. **ASTM F 970**, Standard Test Method for Static Load Limit.

E. **ASTM F1303**, Standard Specification for Sheet Vinyl Floor Covering with Backing.

F. **ASTM F2170**, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

G. **(RFCI)** Resilient Floor Covering Institute
   1. RFCI Standard Slab Moisture Test Method (Calcium Chloride Method) as a supplementary test method to ASTM F2170.

H. **ASTM F 3010 Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings**

I. **DIN 51130 Slip Resistance Test**

J. **ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials**

K. **RFCI Recommended Work Practices for Removal of Resilient Floor Covering**

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's current printed product literature, Specifications, installation instructions, and field reports in accordance with AIA A232 and Section 00800 - Submittal Procedures.

B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with AIA A232 and Section 00800 - Submittal Procedures including but limited to the following:
   1. Submit a cut diagram indicating seam locations and roll direction. Use mitered seam layouts for corners when changing directions 180 degrees (e.g. when running material down corridors which bisect at a right angle), unless approved otherwise.

C. Samples: Submit duplicate 6" x 9" (152 mm x 228 mm) sample pieces of sheet material, 6" (152 mm) long cap strip and cove former in accordance with AIA A232 and Section 00800 - Submittal Procedures.

D. Closeout Submittals: Submit the following:
   1. Maintenance Data: Submit manufacturer's maintenance data for incorporation into manual specified in accordance with Section 01700 – Closeout Submittals. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing Work of this section who has specialized in installation of Work similar to that required for this project.
   1. Training: Installer who has attended an Altro flooring; or approved equal, installation training clinic or who has successfully installed the flooring product previously.
   2. Awarded flooring Subcontractor must use in-house installers.
   3. Awarded flooring Subcontractor must be able to provide recent Altro; or approved equal, references with contacts.

B. Mock-ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing.
   1. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
   2. Incorporation: Mock-up may be incorporated into final construction upon Architect's and Construction Manager's approval.

C. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, manufacturer's warranty requirements, and installer qualifications.

D. Bond Test: Install multiple bond tests using 3′ x 3′ pieces of material adhered with the appropriate adhesive to verify quality of adhesion. Remove half of each piece after 24 hours, then the other half after 48 hours. To help assess resistance to indentation, place end user equipment onto a sample for 72 hours. Document all results.

1.5 SITE CONDITIONS

A. Temperature Requirements: If storage temperature is below 65F (18C) or the floor

temperature is below 50F (18C), the flooring product must be moved to a warmer place and allowed to reach this temperature before unrolling or installation. For further information, refer to current manufacturer's Installation Practices and Quick Facts.

B. Maintain air temperature and structural base temperature at flooring installation area between 68F (20C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

1.6 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver, store and handle resilient flooring materials in accordance with Section 016-0 - Product Requirements.

C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.

E. Store rolls in dry locations. Stand rolls on end. Protect and secure rolls from falling.

1.7 WASTE MANAGEMENT AND DISPOSAL

A. Deposit all packaging materials in appropriate container on-site for recycling or reuse.

B. Avoid using landfill waste disposal procedures when recycling facilities are available.

C. Keep all discarded packaging away from children.

1.8 WARRANTY

A. Warranty period for Altro Operetta; or approved equal, shall be **ten (10) years** commencing on date of substantial completion. Refer to conditions of the Contract for project warranty provisions.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOORING

A. Resilient Sheet Vinyl Manufacturer: Altro Operetta by Altro; or approved equal.

B. Basis of Design Material: Altro Operetta; or approved equal, (measurements and product weights listed are approximate):
   a. Slip Resistance ASTM D2047 .7 Dry, .8 Wet.
   b. Thickness: 2.0 mm.
   c. Roll Width: 6' 7" (2 m).
   d. Roll Length: 66' (20 m);
   e. Weight: 4.9 lbs /yd2.
   f. Altro Operetta; or approved equal, uses a non-woven polyester/cellulose, glass fiber reinforcement.

C. Sound Insulation
   1. Altro Operetta; or approved equal, provides 4dB of sound insulation.

D. Color:
   1. Color to be selected from manufacturer's current range of colors.

2.2 ACCESSORIES

A. Including but not limited to:
   1. Vinyl welding rod: Acceptable material:
      a. Altro Weld Rod; or approved equal.

B. Cove former: Acceptable material, sized to suit application:
   1. Altro Cove; or approved equal, former 20R - 24 mm (1") radius.

C. Cap strip: Acceptable material, sized to suit application, vinyl:
      a. Altro Cap Strip C4; or approved equal.

D. Subfloor Filler and Leveler: Use only grey Portland cement-based "moisture tolerant" underlayments, and patching compounds. Use for filling cracks, holes or leveling. White gypsum materials **are not** acceptable.

E. Metal edge strips:
   1. Aluminum extruded, smooth or mill finish stainless steel with lip to extend over flooring as selected by the Architect.

F. Adhesives
   1. Leveling and Patching Compounds: Latex-modified, moisture resistant, silicate free, Portland cement based or blended hydraulic-cement-based formulation.
   2. Adhesives:
      a. Altrofix 30- 2-part polyurethane; or approved equal, for areas prone to moisture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog, installation instructions.

B. 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.

3.2 PREPARATION

A. Remove substrate paint, coatings and other substances that are incompatible with adhesives or contain soap, wax, oil, solvents, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Permanent and non-permanent markers, pens, crayons, and paint shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.

C. Smooth flooring shall be installed over subfloors conforming to ASTM F710 for concrete and other monolithic floors.

D. Always conduct moisture tests per ASTM F-2170 on all concrete slabs regardless of age or grade level. ASTM F-2170 Internal Relative Humidity (IRH) test results must not exceed 90%. Alkalinity Testing per ASTM F710 with an acceptable range of 7-9.9 pH.

E. Do not proceed with Work until results of moisture condition tests are acceptable.

F. When patching, a *moisture tolerant* patching compound must always be used.

G. Contingency for High Moisture Readings in Concrete:
   1. If at the time of installation the moisture readings are in excess of manufacturer's recommendations, the Contractor shall employ a means of Moisture Mitigation. This includes, but is not limited to, the following methods:
      a. Application of a Moisture Reduction Barrier (MRB)
      b. Temporary use of dehumidification equipment.
      c. Postponing of the flooring installation start time.
      d. A budget should be provided to the Contractor for use of an MRB

3.3 INSTALLATION

A. Installation: Install Altro Operetta; or approved equal, flooring in accordance with the current posted manufacturer's Installation Practices, Downloads, Technical Documents and Installation Guides. All Seams shall be heat welded with Altro Weldrod™; or approved equal, only. Failure to install indicated flooring in accordance with recommended procedures will void the manufacturer's Limited Product Warranty.

B. Drains: Fit Altro; or approved equal, flooring and mechanically fasten to drain outlets to ensure a permanent, watertight installation. The installation of the flooring in a wet environment is a system installation. All circular drain covers must be modified in the field or specified by the Architect to be Surface-Membrane Clamping Style Drains and installed per the instructions in the Flooring installation guide. The AltroMastic, Cove Former, and Cap Strip; or approved equal, accessories are necessary accessories for a water-tight and manufacturer-compliant installation.

C. Coved Installation: Where flooring is coved up wall surfaces and other abutments, installation shall be in accordance with manufacturer's Installation Practices using the following accessories:
   1. At standard wall finishes: Use Altro C5 vinyl cap strip; or approved equal, to accommodate sheet vinyl to a height as indicated; adhere with contact tape.
   2. At FRP paneling: Use Altro C4 cap; or approved equal.
   3. Top set cove base: Install in accordance with manufacturer's instructions.

3.4 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas.
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
   3. Current recommended maintenance procedures Downloads, Technical Documents, Maintenance Guides.

B. Protection:
   1. Sweep or vacuum all construction debris and dust first, then clean the flooring with AltroClean 44 /AltroClean 44 Plus; or approved equal, using an auto scrubber.
   2. Cover and protect finished installation from damage from Subcontractors using a non-staining, temporary floor protection system, such as reusable textured plastic sheeting.
   3. Never use tapes on the surface on the finish flooring, Sharpies, pens, crayons or construction markers on either the finish flooring or the substrate.
   4. No traffic for 24 hours after installation, unless approved by the manufacturer.
   5. No heavy traffic, rolling loads, or furniture placement for 72 hours after installation.
   6. Wait 72 hours after installation before performing initial cleaning. Start a regular maintenance program after the initial cleaning as recommended by manufacturer.

3.5 PROTECTION

A. Cover and protect finished installation from damage from Subcontractors using a non-staining, temporary floor protection system, such as a reusable textured plastic sheeting.

B. Altro Operetta; or approved equal, should be covered and protected from all Subcontractors during construction with a suitable non-staining protective covering without taping to the surface of the flooring.

END OF SECTION 09657

SECTION 09720 – HYGENIC WALL COVERINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes labor, materials and other services necessary to complete vinyl wall coverings.

B. Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the Work of this Section.

1.2 RELATED SECTIONS

A. Section 04200 – Unit Masonry

B. Section 09657 – Commercial Smooth Sheet Vinyl (Floor)

C. Division 15 – Plumbing Work

1.3 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this Specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Society for Testing & Materials (ASTM) and ISO:

1. ASTM E 84-05 Standard Test Method for Surface Burning Characteristics of Building Materials. CLASS A
2. ASTM D5420 Gardner Impact Exceeds 198-inch pounds
3. ISO 14644 9:12 Standard Laboratory Practice for Quantifying Air Cleanliness by Particle Concentrations – Meets ISO 2
4. CA 03150 Measures VOC Emissions
5. DIN IEC 60 167 Surface Resistance
6. ASTM G21 Fungi Resistance
7. ASTM D3273 Mold Resistance
8. ISO 62 Water Absorption
9. ASTM G154 UV Exposure
10. FDA Compliant
11. USDA Compliant
12. EN 684 Seam Strength Test (result 897 N/50 mm)

C. Plumbing Code Compliance

1. National Standard Plumbing Code, 2021

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: Provide Altro Whiterock; or approved equal, wall covering which has been manufactured by Altro; or approved equal and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's current printed product literature, Specifications,

installation instructions, and field reports in accordance with AIA A232 and Section 00800 - Submittal Procedures.

B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with AIA A232 and Section 00800 - Submittal Procedures including but limited to the following:

1. Submit a layout diagram indicating the location of each panel and joining method.

C. Samples: Submit duplicate sample pieces of Altro Whiterock material; or approved equal, as well as accessory pieces in accordance with AIA A232 and Section 00800 - Submittal Procedures.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
2. Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
3. Manufacturer's Field Reports: Specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
2. Warranty: **Twenty (20) years** from date of substantial completion.

1.6 QUALITY ASSURANCE

A. **Installer Qualifications: Current Installers who have passed the Altro Whiterock; or approved equal, installation instruction and have successfully installed the indicated product.**

B. Mock-ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's, Construction Manager and Architect's acceptance of finish color, texture and pattern, and workmanship standards.

1. Mock-Up Size: 4′ x 4′.
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

C. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver, store and handle Altro Whiterock; or approved equal, wall panels in accordance with Section 01600 - Product Requirements.

C. Deliver materials in manufacturers' original, unopened, undamaged containers with identification labels intact.

D. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer. Panels should be stored flat and be pre-conditioned a minimum of 72 hours in ambient temperatures similar to the prevailing operational conditions.

E. Store panels in temperature-controlled environments. Leave protective blue film on panel until ready to use.

F. Altro Whiterock; or approved equal, adhesives and accessories must be stored in enclosed, dry conditions not subjected to freezing or excessive heat. Heat above 140F (60C) will distort and damage the material. Cold temperatures will make the material brittle and temperatures below 23F (-5C) should be avoided during storage.

G. When stacking pallets, they should not be stacked more than 8 pallets high and stacked flat without bumps or rolls and in a square and well aligned configuration. Safety precautions should be taken to secure pallets to prevent shifting or falling.

H. Panels and all Altro; or approved equal, materials are to be acclimated on-site 72 hours prior to installation. HVAC is to be up and running with ambient temperatures between 68F (20C) and 80F (27C) through to 24 hours after installation.

I. Maintain air temperature and structural base temperature at between 68F (20C) and 80F (27C) for 72 hours before, during and 24 hours after installation.

J. Verify permanent HVAC is operational. If temporary heat is required, use electric or indirect heat sources. Do not use kerosene or propane in direct contact with the ambient air.

K. Verify other finishing operations, including painting, have been completed.

1.8 WASTE MANAGEMENT AND DISPOSAL

A. Deposit all packaging materials in appropriate container on site for recycling or reuse.

B. Avoid using landfill waste disposal procedures when recycling facilities are available.

C. Keep all discarded packaging away from students / children.

1.9 PROJECT CONDITIONS

A. Temperature Requirements: If storage temperature is below 68F (20C), the Altro Whiterock; or approved equal, wall panel must be moved to a warmer place and allowed to reach this temperature before installation. For further information, refer to current Installation Guide.

B. Maintain air temperature and structural base temperature at installation area between 68F (20C) and 80F (27C) for 72 hours before, during and 24 hours after installation.

C. Allow sufficient time for proper preparation, installation and curing.

D. Close spaces to traffic during installation until the installer is satisfied that the adhesive has set.

E. Verify permanent HVAC is operational. If temporary heat is required, use electric or indirect heat sources. Do not use kerosene or propane in direct contact with the ambient air.

F. Verify other finishing operations, including painting, have been completed.

G. If more than one pallet of material is used, use material in sequence.

H. Panels and all other materials must be checked for defects before installation. Do not install materials with visible defects.

I. **Do not install near open heat sources.**

1.10 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Bid Documents.

C. Warranty Period shall **be twenty (20) years** commencing on Date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Provide extra materials of product and adhesives in accordance with Section 01700 - Closeout Submittals.

B. Provide 4 sq.ft of each color, pattern and type material required for project for maintenance use.

C. Provide 4 sq.ft of extra materials in one piece and from same production run as installed materials.

D. Clearly identify each wall panel and each container of adhesive.

E. Deliver to Consultant, upon completion of the work of this section and store where directed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Altro USA; or approved equal.

2.2 HYGIENIC WALL COVERINGS

A. Altro Whiterock™; or approved equal, is 100% pure vinyl, extruded, semi-rigid PVCu sheet. Contains no plasticizers or fillers and is homogenous.

B. Basis of Design material: Measurements and product weights given below are approximate):
   1. Thickness: 0.10" (2.5 mm); Panel height: 4' (1.22m) Panel width (as indicated on

the drawings).

2. COLORS:
   a. As selected by the Owner / Architect from the manufacturer's full color line: Satins and Matte.

2.3 ACCESSORIES - Including but not limited to:

A. Vinyl welding rod: Acceptable material:
   1. Altro weld rod – Match panel color

B. Joint Strips: 2-Part Joint Strip (8' or 10') – to match panel color.

C. Start and Edge Trim
   1. 1-Part Start and Edge Trim –Length, as required.

D. Stainless Steel Accessories:
   1. Stainless Steel Corner Protector – [A861/12] Dimensions: 4' x 3" x 3"

E. Acrylic Adhesive: For porous, even substrates (and climate-controlled areas) use Altro W157; or approved equal, one-part, water-based, acrylic adhesive as recommended by the manufacturer.

F. Polyurethane Adhesive: For wet, non-porous substrate (and areas subject to temperature fluctuations) use Altro W39; or approved equal, 2-Part Adhesive.

G. Sanitary Sealant Compounds and Tape Adhesion Promoter:
   1. Altro Sanitary Sealant; or approved equal, to match panel color, 10.5 oz Tube.
   2. Ecofix 75; or approved equal, Spray Adhesive.

H. Double-Sided Tape:
   1. 2" Double-Sided Tape A815/216 – 33 LM roll; or approved equal.

I. Wall-To-Floor Heat-Weld:
   1. WSBU200; or approved equal, Vinyl Backer – 15lm coil – used behind coved flooring when welding panels to floor

2.4 SOURCE QUALITY

A. Source Quality: Obtain Wall products from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions and product label instructions for installation.

3.2 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 the manufacturer's instructions.

3.3 SUBSTRATE PREPARATION

A. Walls should be smooth and level. High points must be removed and low points filled with filler intended for the substrate and environmental conditions.

B. Surfaces must be permanently dry and free from all substances that may contribute to adhesive bond failure.

C. Remove loose paint and conduct an adhesive bond test with paint.

3.4 PREPARATION

A. All surfaces must be free from dust and cleaned prior to product installation. The working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate and may cause the wall panels to de-bond.

B. Very absorbent / porous substrates (particularly plaster finishes and unprimed sheetrock) must have a proprietary sealer e.g. PVA primer or similar, applied to the surface a minimum of 12 hours prior to the installation.

C. All electrical switches, power points etc., should be in a first fix / installation state. All electrical equipment should only be moved or altered by a qualified electrician.

D. All plumbing should have pipework removed to a first fix or installation state and "tails" left protruding from the substrate. Panels can then be drilled and slid over the pipe tails. All holes should be drilled 1/8" (3mm) oversize to allow for expansion, then sealed with the manufacturer's sanitary sealant. Plumbing should always be done by a qualified plumber.

E. Hot pipes should be insulated and a 1/8" to 1/4" (3-6mm) expansion gap should be created when installing panels around these pipes, then sealed with manufacturer's sanitary sealant.

F. All pipes, fixing bolts, etc. extending through the panels should have a minimum 1/8" (3mm) expansion gap and be sealed using manufacturer's sanitary sealant.

G. If fitting to doorframes, these must be in place prior to installation of Altro Whiterock; or approved equal.

H. Prior to installation, it is advisable to complete any painting which comes in contact with the panels, as sealant used at junctions is non-paintable.

I. Panels should be stored flat and be pre-conditioned a minimum of 72 hours in ambient temperatures similar to prevailing operational conditions.

J. The panels must be stored on a level, flat surface off the ground (risk of condensation on the panels if stored on damp surfaces). Storage on uneven surfaces could cause the panels to distort prior to installation.

K. First, check the room using a 6' (2 m) level to ensure all walls are flat, paying particular attention to the corners, window reveals, and door entrances. These need to be inspected to ensure they are free of any debris or irregularities, which could prevent the panels laying flat to the substrate after the adhesive has been applied and the panel installed.

3.5 INSTALLATION

A. Hygienic Wall Installation: Install panels in accordance with the current manufacturers'

installation guide. All joints should be joined by approved methods as detailed in the installation guide. Failure to install panels in accordance with recommended procedures will void the product warranty.

3.6 CLEANING

A. Once all panels and joints are installed, remove protective film and clean all surfaces down with antistatic solution or antistatic wipes. This is required as the panel may have static build up and any dust in the atmosphere will adhere to the surface of the panel.

1. Panels can be cleaned with a diluted soap/detergent solution, see current maintenance.
2. When cleaning the panel surface, the manufacturer recommends the temperature of water does not exceed 140° F (60° C).
3. Pressure cleaning with hot water may be used with the pressure nozzle a minimum of 2 feet (600 mm) away from the surface.
4. To reduce the buildup of static, cleaning the panels with an anti-static solution is recommended.
5. For stubborn stains use AltroClean 44; or approved equal, cleaner in correct dilution, or equivalent alkaline cleaner, please refer to current maintenance guidelines.
6. Remove construction debris from project site and legally dispose of debris.
   a. If a construction waste separation / disposal workplan is incorporated in the project, ensure this section references how the excess material can be recycled or disposed. Avoid sending construction waste to landfill sites if alternative methods are available.

END OF SECTION 09720

SECTION 09900 - PAINTING

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.

B. Related Sections:

1. Section 03300 - Concrete Work.
2. Section 04200 - Unit Masonry.
3. Section 05400 - Miscellaneous Structural Steel.
4. Section 05500 - Metal Fabrications.
5. Section 08110 - Hollow Metalwork.
6. Section 08211 - Wood Doors for light frames.
7. Section 09250 - Gypsum Drywall.
8. Division 15 - Mechanical Work.
9. Division 16 - Electrical Work.

1.2 DESCRIPTION OF WORK

A. Extent of painting work is indicated on Drawings and schedules, and as herein specified.

B. Work includes painting and finishing of interior exposed items and surfaces throughout project, except as otherwise indicated.

1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.

C. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

D. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.

E. Following categories of work are not included as part of field-applied finish work.

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for miscellaneous structural steel, miscellaneous metal, hollow metal work, and similar items. Also, for fabricated components such as architectural woodwork, wood casework, and shop fabricated or factory built mechanical and electrical equipment or accessories. This is in addition to the prime coat specified herein.

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2. Pre-finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) acoustic materials, architectural woodwork and casework, and shop fabricated or factory built mechanical and electrical equipment, including light fixtures.

3. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, pipe spaces.

4. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.

5. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.

6. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment, identification, performance rating, name, or nomenclature plates.

F. Mechanical and Electrical Work: Painting of mechanical and electrical work is specified herein.

1. Painting of mechanical and electrical work is limited to those items exposed to view.

2. Mechanical items to be painted include, but are not limited to, the following:
   a. Piping, pipe hangers and supports.
   b. Ductwork, insulation.
   c. Access doors and service panels.

3. Electrical items to be painted include, but are not limited to, the following:
   a. Conduit and fittings.
   b. Backboxes.
   c. Junction boxes.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

C. Coefficient of Friction: The Federal and industry standard for testing coefficient of friction or the slip resistance of a surface is tested to the requirements, as outlined, in ASTM D-2047, which utilizes a friction measurement machine, commonly referred to as the James Machine.

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D. Industry Standards: Comply with industry standard established by the Painting and Decorating Contractors of America PDCA for applications, methods and recommendations and use of tools and equipment for paint and stain coatings, primers and block fillers.

E. Lead and Chromate Contents:

1. All paint products must be free of any lead or chromate contents.

F. Volatile Organic Compound Compliant (VOC.):

1. All paint products must meet the State VOC environmental regulations (OTC Regulation compliant) and the following:
   a. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
      (1) Primer, Sealer and Undercoater: VOC content of not more than 200 g/L.
      (2) Specialty Primer, Sealer and Undercoater: VOC content of not more than 350 g/L.
      (3) Rust Preventative Coating: VOC content of not more than 400 g/L.
      (4) Flat Paints and Coatings: VOC content of not more than 100 g/L.
      (5) Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
      (6) Nonflat High Gloss Coatings: VOC content of not more than 250 g/L.
      (7) Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

G. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these Specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other Trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

1. At galvanized surfaces, primer shall be a zinc dust-zinc oxide coating.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.

B. Samples: Prior to beginning work, Contractor shall furnish color chips (2 fan decks) for surfaces to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

1. On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.

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C. Acknowledgment of Bid Documents: Contractor / Installer shall submit to the Architect certifications signed by each of the Contractor and Installer attesting acknowledgment of requirements of the Bid Documents for specific project requirements indicated in this Specifications.

1. Installer shall submit proof of evidence, (this project Specification section) with their letter of certificate.

2. Contractor / Installer shall not proceed with painting work of this section until submittal of required certifications are completed.

3. Any work performed prior to completion of this submittal shall be subject to total rejection by the Architect. All rejected work shall be rectified without any additional cost to the Owner.

E. Coating Maintenance Manual: Upon conclusion of the project, the Contractor in conjunction with the coating manufacturer shall furnish a coating maintenance manual such as the Sherwin-Williams "Custodian Project Color and Product Information" report or approved equal. Manual shall include an area summary with finish schedule, area detail designating where each product/color/finish was used, product data pages, SDS pages, care and cleaning instructions, touch up procedures and color samples of each color and finish used.

1.5 DELIVERY AND STORAGE

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.
2. Fed. Spec. number, if applicable.
3. Manufacturer's stock number and date of manufacturer.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.

1.6 JOB CONDITIONS

A. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

B. Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

C. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

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D. Provide sufficient temporary illumination producing overall space/room minimum illumination level of 50 ft. candles while preparing or painting of surfaces and to assure the production of quality finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to the following:

1. M A B
2. Benjamin Moore
3. The Pittsburgh Paints Company
4. The Sherwin-Williams Company
5. Linetec Inc.
6. Or approved equal

2.2 COLORS AND FINISHES

A. Prior to beginning work, Contractor shall furnish color chips for surfaces to be painted from manufacturers full line of products. This shall include custom colors.

1. Contractor shall allow for a total of 20 different colors of each type of paint, (excluding graphics and /or art work as indicated) with change of color within a room or space occurring either on a horizontal or vertical line, [allow for multiple (6) colors at each room unless otherwise shown]. Where roof structure is exposed, steel beams, steel joists and metal decking will be painted with different colors, as selected by the Architect.

2. Contractor shall allow for split frames at all new and existing hollow metal door and borrowed lite frames to be painted.

3. Final acceptance of colors will be from samples supplied on the job.

B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

2.3 MATERIALS

A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Provide undercoat paint recommended and produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

2.4 INTERIOR PAINT SCHEDULE

A. Semi-Gloss (Satin) Enamel:

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1. 1st Coat: Sherwin-Williams, Pro Industrial Pro-Cryl Universal Primer.

2. 2nd Coat: Acrylic Enamel, Sherwin-Williams, Pro Industrial HP Acrylic.

3. 3rd Coat: Acrylic Enamel, Sherwin-Williams, Pro Industrial HP Acrylic.

4. Apply to following interior surfaces: Hollow metal work, metal lites for wood doors, miscellaneous steel and ferrous metal fabrications.

5. Apply as many coats as necessary to produce a uniform substrate and finish appearance.

B. Egg-Shell / Satin Enamel - Acrylic Latex:

1. Base Coats: Enamel Undercoat; Primer-Sealer to suit substrate or Loxon Block Surfacer for Concrete Masonry/CMU Block.

* Block Filler shall be Level 3 - Premium Fill; one or multiple coats for high performance block filler in accordance with PDCA industry standards. Apply mock-up to confirm appearance before application of finish coats.

2. 2nd Coat: Sherwin-Williams, ProMar 200 Zero VOC Eg-Shel.

3. 3rd Coat: Sherwin-Williams, ProMar 200 Zero VOC Eg-Shel.

4. Apply to the following interior surfaces: Concrete masonry units, gypsum drywall and other interior assemblies to receive paint.

5. Apply as many coats as necessary to produce a uniform substrate and finish appearance.

C. Flat - Acrylic Latex:

1. 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer.

2. 2nd Coat: Sherwin-Williams, ProMar 200 Zero VOC Flat Interior Latex Flat.

3. 3rd Coat: Sherwin-Williams, ProMar 200 Zero VOC Flat Interior Latex Flat.

4. Apply to following interior surfaces: Interior surfaces of ducts, where visible through registers or grilles, etc.

5. Apply as many coats as necessary to produce a uniform substrate and finish appearance.

D. Concrete Floor Sealer: Clear Acrylic Waterborne Concrete Sealer; (Non-slip coating for concrete floor sealer finish):

1. 1st Coat: Floor-Tex; Seal Krete Inc., as distributed by Sherwin-Williams or approved equal.

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2. 2nd Coat: Floor-Tex; Seal Krete Inc., as distributed by Sherwin-Williams or approved equal.

3. Apply to concrete floors where concrete sealer is indicated on finish schedule.

4. Apply as many coats as necessary to produce a uniform substrate and finish appearance.

2.5 EXTRA STOCK

A. Contractor shall provide one gallon of extra stock for each color/type selected for use on the project. Provide unopened containers clearly marked with manufacturers color number and name.

PART 3 - EXECUTION

3.1 INSPECTION

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions, included rotted or otherwise defective materials, have been observed by all concerned and corrected in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

A. General:

1. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

2. Provide barrier coats over incompatible primers or remove and reprime, as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

3. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

4. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

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5. Painting of materials shall commence only when the moisture content of the materials complies with manufacturer's recommendations as follows:
    a. Concrete and masonry - 22% maximum.
    b. Gypsum drywall - 12% maximum.

B. Cementitious Materials:

1. Prepare cementitious surfaces of concrete, concrete block and gypsum drywall board to be painted by removing efflorescence, chalk, dust, dirt, grease, oils and by roughening as required to remove glaze.

2. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

3. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

C. Ferrous Metals:

1. Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

2. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these Specifications. Clean and touch-up with same type shop primer.

3. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

D. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

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3.4 APPLICATION

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Where finish schedule calls for walls, floors or ceilings to be painted, paint all new and existing surfaces in same area. Paint from corner to corner on walls, floors, or ceilings, or to a major change in direction of surface to be painted. Provide crisp, clean, sharp lines where new painted surfaces abut existing painted surfaces.

C. **Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.**

D. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

E. Sand lightly between each succeeding enamel coat.

F. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

G. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

H. **Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by coating manufacturer and an acceptable finished appearance in finish, color and appearance as determined by the Architect.**

I. Primer Coat: Apply primer coat of material which is required to be painted or finished, and which has not been prime coated by others.

   1. **Re-coat primed and sealed surfaces 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.**

J. **Block Fillers: Apply block fillers using manufacturer's recommended application techniques with sufficient material and coats to achieve a pinhole-free, "Level 3 - Premium Fill Surface", and in accordance with PDCA 's industry standards.**

K. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

L. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

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3.5 CLEAN-UP AND PROTECTION

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

B. Upon completion of painting work, clean all paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. 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.

2. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION 09900

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SECTION 09940 – HIGH IMPACT CORNER GUARD

PART 1 - GENERAL

1.01 SUMMARY

A. High impact corner guard system for wall protection.

1.02 RELATED SECTION(S)

A. Section 09250 – Gypsum Drywall.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)
B. National Fire Protection Association (NFPA)
C. Society of Automotive Engineers (SAE)
D. Underwriters Laboratory (UL)
E. International Building Code (IBC)

1.04 SYSTEM DESCRIPTION

A. Performance Requirements: Provide corner guard system that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, InPro Corporation; or approved equal.

1. Fire Performance Characteristics: Provide UL Classified corner guards conforming with NFPA Class A fire rating. Surface burning characteristics, as determined by UL-723 (ASTM E-84), shall be flame spread of 10 and smoke development of 350 - 450.

2. Self-Extinguishing: Provide corner guards with a CC1 classification, as tested in accordance with the procedures specified in ASTM D-635-74, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position, as referenced in UBC 52-4-1988.

3. Impact Strength: Provide rigid vinyl profile materials that have an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.

4. Chemical and Stain Resistance: Provide corner guards that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.

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5. GREENGUARD Certified: Provide GREENGUARD Certified material. Profiles shall meet the requirements of GREENGUARD Certification Standards for Low-Emitting Products and GREENGUARD Product Emission Standard for Children & Schools.

6. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.

7. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

1.05 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each type of corner guard specified.

B. Detail Drawings: Mounting details with the appropriate adhesives for specific project substrates.

C. Samples: Verification samples of corner guard, 8" (203mm) long, in full size profiles of each type and color indicated.

D. Manufacturer's Installation Instruction: Printed installation instructions for each corner guard.

1.06 DELIVERY, STORAGE AND HANDLING.

A. Deliver materials in unopened factory packaging to the jobsite.

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate-controlled location away from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Products must be installed in an interior climate-controlled environment.

1.08 WARRANTY

A. Standard IPC **Limited Lifetime** Warranty against material and manufacturing defects.

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PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: IPC Door and Wall Protection Systems as manufactured by InPro Corporation; or approved equal.

B. Provide all corner guards and wall protection from a single source.

2.02 MANUFACTURED UNITS

A. Corner Guard System:

1. 160 High Impact Corner Guard Profile
2. 2" (51mm) x 2" (51mm), 90 degrees
3. 4′ (1.22m), 8' (2.44m) and 9' (2.74m) standard heights
4. Custom heights available
5. Custom Angles – Provide vinyl covers and retainers with custom angles. Custom angles shall be between 112.5° and 157.5°. Provide flexible top caps to bend to retainer angle.

2.03 MATERIALS

A. Vinyl: Snap on cover of .080" (2mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).

B. Aluminum: Continuous aluminum retainer of .070" (1.8mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.

2.04 COMPONENTS

A. Top caps and bottom caps shall be made of injection molded thermoplastics.

B. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.

C. Optional flexible top caps shall be made of injection molded Biopolymer Flex PVC.

2.05 FINISHES

A. Vinyl Covers: Color of the corner guard to be selected by the Architect from the manufacturer's standard colors. Surface shall have a pebblette texture.

B. Molded Components: Top caps and bottom caps shall be of a color matching the corner guards. Surface shall have a pebblette texture.

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PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions in which the corner guard systems will be installed.

1. Complete all finishing operations, including painting, before beginning installation of corner guard system materials.

B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION

A. General: Locate corner guard as indicated on the approved detail Drawings for the appropriate substrate and in compliance with the IPC installation instructions. Install corner guard level and plumb at the height indicated on Drawings.

B. Installation of High Impact Surface Mount Corner Guard:

1. Position the aluminum retainer against the wall, allowing 5/16" (8mm) from the bottom of the aluminum to the top of the cove base or baseboard for the bottom cap.

2. Aluminum Retainer Installation:
   a. Drywall Installation: Secure the aluminum retainer to the wall using 1-1/4" phillips round head self-tapping screws. Use 6 screws per 4' (1.22m) length, 10 screws per 8' (2.44m) length, or 12 screws per 9' (2.74m) length. The aluminum retainer is pre-slotted to aid in the installation.
   b. Concrete Installation: Drill 1/4" holes into the ends of the retainer for top and bottom caps. Use the slotted tabs of the top caps as a template for hole location. Transfer the location of all mounting holes to the wall. Drill 1/4" (6.5mm) holes and position ALLIGATOR anchors into the holes on the wall. Mount the retainer with #10 x 1-3/4" phillips pan head screws and tighten to secure the retainer to the wall.

3. Top and Bottom Cap Installation:
   a. Drywall installation: Overlap the aluminum with the mounting tabs of the top cap and attach them to the

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aluminum retainer using two, 1-3/4" phillips flat head self-tapping screws per cap. Concrete installation: Overlap the aluminum with the mounting tabs of the top and bottom caps and attach them to the aluminum retainer using two, #8 x 1-1/2" phillips flat head screws per cap. When installing flexible top caps on custom angle corner guards, use cup washers and flat head screws to fasten the top caps to the retainer.

4. Position the vinyl cover on the aluminum retainer to check the fit. Adjust the top cap on the aluminum retainer to obtain a tight fit with the vinyl cover. Starting at the top, push the vinyl cover over the aluminum, by pressing over the length until the vinyl snaps securely into place.

3.04 CLEANING

A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

END OF SECTION 09940

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SECTION 10100 - DRY MARKERBOARDS AND EXHIBITION BOARDS

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 DESCRIPTION OF WORK

A. Extent of dry markerboards and exhibition boards is indicated on the Drawings.

B. Type of dry markerboards and exhibition boards specified in this section includes the following:

1. Porcelain enamel steel dry marker boards.

2. Fabricork fabric faced cork exhibition boards.

3. Factory applied trim.

4. Magnetic markerboard tray(s).

1.3 REFERENCES

A. ASTM E84 Standard Test Method for Surface Burning Characteristics for Building Materials.

B. ASTM C540 Gloss for ceramic materials.

C. ASTM C614 for alkali resistance.

D. ASTM D2244 evaluation of color differences.

E. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wires, Profiles and Tubes.

F. ASTM C208-72 for cellulosic fiberboard.

G. ANSI A208.1-79 for particleboard.

H. ANSI H35.1-82 for aluminum temper and alloy.

I. HNSI A424-80 for steel for porcelain enameling.

J. FS LLL-B-810 for tempered hardboard.

K. PEI-1002 Manual and Performance Specification for Porcelain Enamel Writing Surfaces.

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L. BYK-Gardner Surface Distortion.

M. GREENGUARD Indoor Air Quality Certified.

N. GREENGUARD Children and Schools Indoor Air Quality Certified.

1.4 QUALITY ASSURANCE

A Manufacturer: Furnish all dry markerboards and exhibition boards by a single manufacturer for the entire project.

B. Surface Burning Characteristics: Provide exhibition board surfaces which are identical in composition to those with surface burning characteristics indicated below, as determined by testing in compliance with ASTM E84. Use only exhibition boards which are certified to meet the following standards:

1. Flame Spread: Not more than 25.
2. Smoke Developed: Not more than 40.

C. Uniformity of color, corrosion, temperature, alkali, water, range of gloss test, uniform texture, light reflectance and cleanability are requirements for all groups and have specific ranges for each.

D. Product Certifications: Provide GREENGUARD Indoor Air Quality Certified and GREENGUARD Children and Schools Indoor Air Quality Certificates for markerboards.

E. Reflectivity of LCSII ceramicsteel Markerboard writing surfaces shall not exceed the following:

1. Gloss Range / 60° Gloss meter GU (Gloss Units)
   a. LCSII ceramicsteel for Markerboard 68 -76% (low gloss surface).
   b. LCSII ceramicsteel for writing surfaces - Surface Distortion reduction and the optimum improvement to performance characteristics.

2. Contrast/waviness for Markerboards (light and dark effects) shall be no greater than 15 [Scale 0 – 30] when tested with BYK – Gardner Wave Scan 5+ Measuring device showing visual acuity (contrast sensitivity) to the human eye at distances greater than 3 meters (10'- 0").

3. Resolution (visual acuity) shall be based on 3 lines per degree and be visibly maintained beyond the current standard of 3 meters. [Byk-Gardner Wave Scan 5+ Measuring device].

4. Surface distortion ("orange peel"/surface peaks and valleys) as tested by the BYK-Gardner Wave Scan 5+ Measuring device [Scale 0 – 60]. Values are established by the difference in the highpoint/low point of the Markerboard test surfaces. P 3 ceramicsteel shall establish the lowest range of distortion from 11.7 – 16.02.

1.5 SUBMITTALS

A. Samples and colors for each:

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1. Face sheet materials
2. Cork materials
3. Vinyl materials
4. Aluminum trim types and profiles.

B. Shop Drawings: Submit shop drawings for each type of drymarker and exhibition board. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, layout and installation details.

1. Drawings shall indicate location and actual material lengths of each unit. Room elevations shall indicate joint locations and include dimension from floor and adjacent side walls, cross-sections for trim, backing, face and core materials, fastener spacing and types of units provided.

C. Product Data: Submit manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with requirements.

D. Certification: Submit the manufacturer's certification that materials furnished for the project comply with the specified requirements.

E. Manufacturer's Product Warranty: Submit manufacturer's product and accessories warranty and certificate of authenticity from manufacturer.

F. Product use, regular cleaning, stain removal and precautions information in the operation and maintenance instructions.

1.6 SPECIAL PRODUCT WARRANTY

A. Submit a "**Life of Building**" warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer's instructions and recommendations, porcelain enamel steel markerboard writing surfaces are guaranteed for the Life of the Building. Guarantee covers replacement of defective boards, but does not include cost of removal or reinstallation.

B. Submit a standard warranty, stating that when installed in accordance with manufacturer's instructions and recommendations, exhibition boards are guaranteed for **two (2) years** against defects in materials and workmanship. Guarantee does not cover normal wear and tear, improper handling, any misuse, or any defects caused by vandalism or subsequent abuse. Guarantee covers replacement of defective material, but does not include cost of removal or reinstallation.

C. Writing Surface Warranty Period: **Lifetime of the building** commencing on the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: "Series 1", as manufactured by Claridge Products and Equipment, Inc.; or approved equal.

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1. Finishes and Colors: Shall be selected by the Architect from manufacturer's available full range of finishes and colors including painted aluminum colors.

B. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Manufacturers of Porcelain Enamel Dry Markerboards and Exhibition Boards:
   a. Aarco Products Inc.
   b. Educational Equipment.
   c. Platinum Visual Systems
   d. Or approved equal

2.2 MARKERBOARD MATERIALS

A. Porcelain Enamel: Provide balanced, high pressure laminated porcelain enamel markerboards of 3-ply construction consisting of facing sheet, core material and backing.

1. Face Sheet: LCS-II Porcelain Enamel grade cold rolled steel for markerboard, as indicated on Drawings.
   a. Coat the exposed face with a 3-coat process consisting of primer, ground coat and color cover coat, and the concealed face with a 2-coat process consisting of primer and ground coat.
      1) Bottom Ground Coat – 1.5 to 2.2 mils
      2) Top Ground Coat – 2.0 to 2.8 mils
      3) Top Cover (Color) Coat – 3.0 to 4.0 mils
   b. Fuse cover and ground coats to the steel at the manufacturer's firing temperatures, but not less that 1,200 deg.F (649°C).
   c. LCS-II Porcelain Enamel for markerboard with improved writing and erasing surface (3 colors low gloss and 3 colors high gloss)
   d. Facing sheet construction:
      1) 1.7-2.5 mils enameled ground coat on face minimum thickness.
      2) 3.0 – 4.0 mils enameled cover (color) coat for markerboard.
      3) 1.7-2.5 mils enameled minimum ground coat on back of facing.
      4) Firing temperatures shall be a minimum of 1200°F for LCSII markerboard.

2. Writing Surface Core: 7/16" Medium Density Fiberboard (MDF) composed of approximately 90% post-industrial waste.
   a. Units over 12'-0" in length and longer will require H-bar at center.

3. Moisture backer shall be factory laminated to core material. A 0.005" thick aluminum backer shall be provided standard on all markerboards.

4. Perimeter trim shall be as indicated on the Architectural Drawings.

5. Markerboard tray(s): Provide item #264M satin anodized finish magnetic markerboard tray(s). Size: 2-3/4" deep x 12" long with ¾" radius corners.

6. Maprail: shall be provided on all markerboards and will be either 1" or 2", as indicated on the Architectural Drawings/details.
   a. Cork insert to be Claridge; or approved equal, Cork, color as selected by Architect.

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7. Accessories (1″ or 2″):
    a. Maphooks (minimum two per 4' maprail).
    b. Flag holder (one per room).
        1) Provide separate wall mount flagholder, as required. Coordinate locations with locations of projection screens.
    c. Map roller brackets (one pair per markerboard).
    d. Maprail end stops (one pair per display rail).

8. Lamination:
    a. Factory machine type only.
    b. Specially formulated adhesives.

2.3 EXHIBITION BOARD MATERIALS

A. Fabricork: #1380 Vinyl fabric on natural cork underlay with Duracore backing.

B. Thickness: Total laminated thickness of core and covering is ½". All thicknesses are nominal.

C. Vinyl Fabric: 15 oz/In yd.

D. Lamination: Factory machine type with specially formulated adhesive.

E. Metal Trim and Accessories: Factory fabricated frames and trim of not less than 0.062" thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single length units wherever possible; keep joints to a minimum. Miter corners to a neat, hairline closure. Plastic accessories will not be accepted.

2.4 Gallery Display Boards

A. Basis of Design: “Tack Walls” as Manufactured by Claridge Products and Equipment, Inc or approved equal.

B. Fabricork: #1380AEW - vinyl fabric on Duracore backing with edges wrapped. a. Finishes and Colors: Shall be selected by the Architect from manufacturer’s available full range of finishes and colors.

C. Thickness: Total Laminated Thickness of core and covering is 1″. All thicknesses are normal.

D. Vinyl Fabric: 15 oz/in yd.

E. Lamination: Factory machine type with specially formulated adhesive.

F. Panel Size:.
    a. 4'-0" by 8'-0"
    b. Or as indicated on Drawings.

2.5 FABRICATION

A. Assembly: Provide factory assembled dry markerboard and exhibition board units, except where field assembled units are required.

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B. Make joints only where the total length exceeds the maximum manufactured length. Fabricate with the minimum number of joints, balanced around the center of the board, as acceptable to the Architect.

1. Provide the manufacturer's standard vertical joint system between abutting sections of dry markerboard.

PART 3 - EXECUTION

3.1 PREPARATION

A. Field Measurements: Take field measurements prior to the preparation of shop drawings and fabrication where possible, to ensure proper fitting of the work. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay work.

B. 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.

3.2 INSTALLATION

A. Deliver factory-built dry markerboard and exhibition board units completely assembled in one piece without joints, wherever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to the Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Install units in locations and at mounting heights indicated and in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb and level. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trim and accessories necessary for a complete installation.

1. Anchor all components securely using tamperproof fasteners, where accessible.

2. Install all dry markerboards and exhibition boards with completely concealed continuous hangers.

3. Where wall mount flagholders is required install units where directed by the Architect / Owner.

C. Provide factory-trained installers.

D. Apply manufacturers' adhesive behind each board using roughly ¼ cup @ 16" on center.

E. Mounting heights from the floor for each room shall be as follows:

Consult with the Architect / Owner before start of installation:

1. Kindergarten 24"
2. First & Second grades 26"

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3. Third & Fourth grades 28″
4. Fifth and Sixth grades 30"
5. Seventh – ninth grades 33″
6. Tenth and up grades 36″

F. Provide covering for H-moldings to match vinyl-covered boards.

G. Clean boards using manufacturers' recommended procedures and install cleaning labels for each room.

H. Locate accessories on each board as specified.

I. Provide mitered and wrapped hairline joints for all trims.

J. Provide fasteners at perimeter trims 16″ – 24″ and 12″ – 16″ on trays.

3.3 ADJUST AND CLEAN

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units in accordance with the manufacturer's instructions. Break-in markerboards only as recommended by the manufacturer.

C. Repair or replace all damaged units and surfaces to the approval of the Architect at no additional cost to Owner.

END OF SECTION 10100

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SECTION 10440 - SPECIALTY SIGNS

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 DESCRIPTION OF WORK

A. Extent of specialty signs is shown on the Drawings.

B. Forms of specialty signs required include the following:

1. Panel signs (Room Identification Signs).
2. Exterior signs.
3. Installation of all specialty signs.

1.3 QUALITY ASSURANCE

A. Uniformity of Manufacturer: For each sign form and graphic image process indicated furnish products of a single manufacturer.

B. All signs shall conform to the International Building Code and ICC/ANSI A117.1. - 2017 requirements for accessible building elements.

1. All signs to permanent rooms and spaces shall include Braille in accordance with N.J.A.C. 5:23-7.11 (j).

1.4 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 form and material showing finishes, colors, surface textures and qualities of manufacturer and design of each sign component including graphics.

1. Submit full-size sample units, if requested by the Architect. Acceptable units may be installed as part of the work.

C. Shop Drawings: Submit shop drawings for fabrication and erection of specialty signs. Include plans, elevations, and large scale details of sign wording and lettering layout. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

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1. Americraft Inc.
2. Architectural Graphics Inc.
3. ASI Sign Systems, Inc.
4. Bayuk Graphic Systems, Inc.
5. Brandon Signage Co.
6. Designer Sign Company.
7. Gemini
8. Howard Industries
9. Metro Signs.
9. Mohawk Sign Systems.
10. Or approved equal.

2.2 MATERIALS

A. GENERAL: Provide manufacturer's standard plastic signage which comply with the requirements established in the International Building Code and ICC/ANSI 117.1 - 2017 Barrier Free Standards. All signs to permanent rooms and spaces shall include Braille in accordance with N.J.A.C. 5:23-7.11 (j).

1. Acrylic sheet material to be cut to the desired sizes with radius or square corners as indicated, or as per approved shop drawings.

2. Manufacturer's standard acrylic material, as indicated, for Barrier Free Accessible signage indicating International Symbol of Accessibility.

3. "Helvetica Regular" letter style, Domed Grade II Braille and other pictograms as described herein.

4. Colors: As selected by the Architect from manufacturer's standards after award of contract, or as specified herein.

B. Fasteners: Unless otherwise indicated, used concealed fasteners fabricated from metals that are non-corrosive to either the sign material or the mounting surface.

C. Anchors and Inserts: Use non-ferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into masonry work.

2.3 FABRICATION

A. Unframed Panel Signs: Fabricate unframed panel signs with edges mechanically and smoothly finished to conform with the following requirements:

1. Edge Condition: Square cut.
2. Corner Condition: Provide radius corners for each sign type.

2.4 SIGNAGE

A. GENERAL: ALL signage MUST comply with the requirements established in the International Building Code and ICC/ANSI 117.1 - 2017. All signs to permanent rooms and spaces shall include Braille in accordance with N.J.A.C. 5:23-7.11 (j).

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B. INTERIOR SIGNAGE:

1. Room Names and Numbers Signage:
   a. Provide Room Name and Numbers plastic signs for all rooms with name and room number, as shown on drawings and schedules.
      1) Types "7 & 9" Signs - Classrooms and Offices:
         a) Provide 1/4" thick non-combustible, self extinguishing solid composite plastic sign signs with integral tactile letters, numbers and symbols raised a minimum of 1/32" from sign face. Provide window insert with non-glare clear plastic cover
         b) Basis of Design: Provide "Series 200A Sand Carved process with window insert Series 400 Vinyl Copy" as manufactured by Mohawk Sign Systems Inc.; or equal by Brandon Signage Co.; or approved equal.
      2) Type "8" Signs - Multi-Purpose Room, Stage, Cafeteria, Auditorium, Faculty Dining, Main Offices, Media Center, Kitchen, etc. :
         a) Provide sand-carved process, 1/8" thick non-combustible, self-extinguishing solid composite plastic with integral tactile letters, numbers and symbols raised a minimum of 1/32" from sign face.
      3) Informational Signage:
         a) Provide informational plastic signs at selected doors, as shown on drawings and schedules.
            i) Signs - "THIS IS NOT AN EXIT", "EXIT", etc.:
               (1) Provide sand-carved process, 1/8" thick non-combustible, self-extinguishing solid composite plastic with integral tactile letters, numbers and symbols raised a minimum of 1/32" from sign face.
      4) Sizes: As indicated or as directed by the Architect / Owner.
      5) All room signs shall have radius corners.

2. Room Occupant Capacity Signs:
   a. Provide room occupant capacity signs for room capacity more than 50 persons and as indicated.
      1) Provide sand-carved process, 1/8" thick non-combustible, self-extinguishing solid composite plastic with integral tactile letters, numbers and symbols raised a minimum of 1/32" from sign face.

3. Barrier Free Accessibility Signs:
   a. Basis of Design; "Vandal-resistant signs" as manufactured by Americraft Inc.; or approved equal.
      1) Provide injection molded process, 1/8" thick acrylic with non-glare clear front surface, graphics and colors on second surface (Back surface), with radius corners and stepped edging. Provide mounting holes with stainless steel screws. Colors to be selected by the Architect from manufacturer's available full range of colors.
      2) Provide tactile plastic signs displaying international symbol of accessibility in tactile form and accompanied by Grade II Braille.
      3) For Directional Signage, indicate the route to the nearest accessible element.
      4) Provide signage at the following locations and as indicated on the Contract Drawings:
         a) Accessible toilet and bathing units including stalls.

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b) Accessible building entrances.
c) Accessible areas of refuge.
d) Accessible means of egress.

4. Special Signage:
   a. AED Cabinet Signage:
      1) Provide signage where indicated or required by Code, of silk screened copy, on baked enamel aluminum sheet material 0.063 thick, in two colors; with black AED letters, red heart image with white lightning bolt on white background, as otherwise required by Authorities Having Jurisdiction.

5. Signage Locations:
   a. Along the door on the latch side and shall be mounted as follows:
      1) 48" minimum to the lowest tactile character on the sign measured from the finish floor.
      2) 60" maximum to baseline of highest tactile character on the sign measured from the finish floor.
   b. For locations having double doors, mounting shall be to the right of the right hand door.
   c. Where there is no wall space on the latch side of the door, including double leaf doors, signs shall be placed on the nearest adjacent wall.

6. Graphic Content and Style: Provide sign copy to comply with the requirements indicated for sizes, styles, spacing, content, positions, materials, finishes and colors of letters, numbers, symbols and other graphic devices.
   a. Raised Copy Thickness: Not less than 1/32" from the sign face.
   b. Raised characters shall be in different color and meets the Barrier Free requirements for a 70% contrast ratio of colors. Colors shall be selected from manufacturer's available full range of colors.
   c. Raised characters and symbols for tactile signs shall be 5/8" high minimum and 2" high maximum. Sign size shall suit the required letters and numbers.

7. Braille Copy: Braille Copy shall be Grade II and shall conform to Specification 800, National Library Service, Library of Congress. Braille shall be raised integral .0625 diameter.
   a. Braille shall be separated ½" minimum from the corresponding raised characters or symbols.

8. Mounting: As directed by the Architect using required fasteners.

C. EXTERIOR SIGNS:

1. Accessible directional signs to accessible entrances, etc. to be located as shown on Drawings or as indicated herein.
   a. Provide silk screened copy, on baked enamel aluminum, colors as indicated or as otherwise required by Authorities Having Jurisdiction, (Manual on Uniform Traffic Control Devices latest edition) with aluminum post embedded in concrete.
   b. Accessible Entrance Sign: Provide aluminum entrance signs at each indicated entrance, displaying international symbol of accessibility. Provide silk screened copy, blue on white baked enamel.

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2. Fasteners and Anchors: Use manufacturer's recommended type, size and quantity of fasteners for indicated signs. Provide concealed mounting and predrilled holes for setting wall anchors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where shown or scheduled, using mounting methods of the type described and in compliance with the applicable Codes and regulation.

B. Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

C. Wall Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:

1. Silicone Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous or vinyl-covered surfaces.
   a. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
   b. Fasteners and Anchors: Manufacturer recommended concealed types for indicated signage and substrate materials.

2. Fasteners and Anchors: Manufacturer recommended concealed types for indicated signage and substrate materials.

3.2 CLEANING AND PROTECTION

A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10440

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SECTION 10522 - FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

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 DESCRIPTION OF WORK

A. Extent of fire extinguishers, cabinets and accessories is indicated on the Drawings.

B. Definition: "Fire Extinguishers" as used in this section refers to units which can be hand-carried as opposed to those which are equipped with wheels or to fixed fire extinguishing systems.

C. Type of products required include:

1. Fire extinguishers.
2. Fire extinguisher cabinets.
3. Signs.

D. Related Sections:

1. Section 04200 - Unit Masonry
2. Section 07900 - Joint Sealer Assemblies.
3. Section 09250 - Gypsum Drywall.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain products in this section from one manufacturer.

B. Coordination: Verify that fire extinguisher cabinets are sized to accommodate fire extinguishers of type and capacity indicated.

C. 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.

1.4 SUBMITTALS

A. Product Data: Submit product data for each type of product included in this section. For fire extinguisher cabinets include roughing-in dimensions and details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, and panel style and materials.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

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1. Failures include, but are not limited to, the following:
   a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
   b. Faulty operation of valves or release levers.

2. Warranty Period: **Six (6) years** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. J.L. Industries.
2. Larsen's Mfg. Co.
3. Potter Roemer
4. Or approved equal.

2.2 FIRE 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. Fill and service extinguishers to comply with requirements of governing authorities and manufacturer's requirements.

C. Multi-Purpose Dry Chemical Type: UL-rated 2-A:10:B:C, 5 lbs. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.3 FIRE EXTINGUISHER CABINETS

A. General: Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.

B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.

C. Cabinet Type: Suitable for mounting conditions indicated, of the following types:

1. Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.

2. Semi-Recessed: Cabinet box (tub) partially recessed in walls of shallow depth.

3. Provide fire rated UL listed type cabinets.

D. Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.

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E. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: Square edges with backbend depths as follows:
   a. 1/4" to 5/16".

2. Trim Metal: Of same metal as door.

F. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.

1. Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.

G. Door Glazing: Tempered float glass complying with FS DD-G-1403, grade B, style I, type I, quality q3, class as indicated below:

1. Clear glass, class 1 (transparent).

H. Door Style: Manufacturer's standard design as indicated below and on Drawing.

1. Vertical Duo-Panel: Tempered glass, 1/8" thick.

I. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180 degrees.

2.4 SIGNAGE

A. Identification: Signage complying with Authorities Having Jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Basis of Design: “PTD-182"; or approved equal, V-Shaped Sign - ‘FIRE EXTINGUISHER’ with picture of extinguisher on red background; or approved equal.

2.5 FACTORY FINISHING OF FIRE EXTINGUISHER CABINETS

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.

B. Painted Finishes: Provide painted finish to comply with requirements indicated below for extent, preparation and type:

C. Extent of Painted Finish: Apply painted finish to both concealed and exposed surfaces of cabinet components except where other than a painted finish is indicated.

D. Color: Provide color or color matches indicated, or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

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E. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.

F. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply cabinet manufacturer's standard baked enamel finish system to the following surfaces:

1. Interior of cabinet.
2. Exterior of cabinet except for those surfaces indicated to receive another finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

B. 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.

C. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.

D. Where exact location of surface-mounted cabinets is not indicated, locate as directed by Architect.

3.2 IDENTIFICATION

A. Identify existence of fire extinguisher in cabinet with die cut vertical lettering spelling "FIRE EXTINGUISHER" applied to door. Provide lettering to comply with requirements indicated for letter style, color, size, spacing and location or, if not otherwise indicated, as selected by Architect from manufacturer's standard vertical arrangements.

END OF SECTION 10522

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SECTION 10650 - OPERABLE PARTITION

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 partition.

B. Related Sections:
   1. Section 03300 - Concrete Work.
   2. Section 04200 – Unit Masonry.
   3. Section 05120 – Structural Steel: For primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
   4. Section 05400 – Miscellaneous Structural Steel.
   5. Section 09250 – Gypsum Drywall.
   6. Division 16 – Electrical Work.

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 partition(s) 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.

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 E84 - Surface Burning Characteristics of Building Materials.
   4. 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 type of operable partition, component and accessory specified.

B. Shop Drawings: Show location and extent of operable partition. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at opening, 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**: Two (2) years**.

D. Lifetime warranty on hinges.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Manufacturers: Subject to compliance with requirements, provide product by the following:
   1. Modernfold, Inc.
   2. Or approved equal.

B. Door(s) to be manufactured in the U.S.A.

C. Products: Subject to compliance with the requirements, provide the following product:
   1. Acousti-Seal Premier; or approved equal, Electric Panel: Electrically operated continuously hinged operable partition.

2.2 OPERATION

A. Acousti-Seal Premier - Electric Panel; or approved equal: Series of continuously hinged flat panels, electrically operated, top supported with operable floor seals.

B. Final Closure: Side Jamb with overlapping trail panel.

C. Partition shall be operated by:
   1. 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.

D. Electric motor shall consist of: 208-volt, 3-phase.

2.3 PANEL CONSTRUCTION

A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 18-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: 0.50-inch (13mm) NAUF medium density fiberboard, single material or composite layers continuously bonded to panel frame. Acoustical ratings of panels with this construction minimum: 50 STC.

C. Hinges for Panels, Closure Panels, Pass Doors and Pocket Doors shall be:
   1. 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.

D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.

E. Panel Weight: 50 STC = 8 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be: Wall covering and upholstery fabric with surface treatment to resist stains.

B. Panel Trim: Exposed panel trim of one consistent color: As selected by the Architect from manufacturer’s standard colors.

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. Modernfold; or approved equal, 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.

2.6 SUSPENSION SYSTEM

A. #30 Suspension System
   1. Suspension Track: Track shall be structural aluminum. Static loading of track with brackets at 48-inch (1220 mm) centers shall show no failure of track or brackets at 5,000 pounds (2250 kg) point loading at mid-span. Track shall be supported by adjustable steel hanger brackets connected to structural support by pairs of 3/8-inch (9.5 mm) diameter threaded rods.
      a. Exposed track soffit: Track soffit to be integral to track shape and shall be powder-coated off white paint finish. Track must accommodate termination of plenum sound barriers on both sides of track for maximum sound control.
   2. Carriers: One trolley in alternating panels with 3-inch (76.2 mm) diameter glass reinforced nylon, all steel precision-ground ball-bearing wheels. Steel wheeled or reinforced polymer trolleys on aluminum track not permitted. Trolleys shall attach to panels with 1/2-inch (17 mm) diameter pendent bolt mounted to welded steel mounting plate.

2.7 SELECTED OPTIONS

A. Work Surfaces shall be as indicated on Drawings:
   1. Markerboard: White enamel on steel, bonded to the face of the panel with horizontal trim without exposed fasteners. Trim is not acceptable on vertical edges to provide uninterrupted work surface.
   2. Tackboard shall be minimum 5mm corkboard covered with vinyl or fabric. Trim shall not require exposed fasteners. No trim shall be permitted on vertical edges so as to provide uninterrupted work surface.

B. Selected accessories / options:
   1. Pocket Door(s): Acousti-Seal Pocket Door(s) by Modernfold, Inc.; or approved equal. Equipped with electric interlock system. (see manufacturer's Supplement Specification)
      a. Premier pocket door.

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 partition and accessories after other finishing operations, including painting have been completed.

C. Match operable partition by installing panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed or unmatched panels <u>are not</u> acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partition 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 partition is without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partition 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 partition. 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.

END OF SECTION 10650

SECTION 10800 - TOILET AND BATH ACCESSORIES

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 DESCRIPTION OF WORK

A. Extent of each type of toilet accessory is indicated on the Drawings and schedules.

B. Type of toilet accessories required includes but are not limited to the following:

1. Mirrors
2. Grab bars

C. Refer to the Toilet Room Accessories Schedule which identifies items supplied by the Owner and installed by the General Contractor.

1.3 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be 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.

C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

B. Setting Drawings: Provide setting drawings, templates, instructions, and directions for installation of anchorage devices and cut-out requirements in other work.

1.5 WARRANTY

A. Washroom Accessories: Warranty is limited to replacing or repairing, at the manufacturer’s option, transportation charges prepaid by the purchaser, any washroom accessory unit or part thereof which their inspection shall show to have been defective within the limitation of the warranty. Period of warranty is measured from the date of their invoice as follows:

1. Complete unit (except mirrors) - **Two (2) year**s.

2. Stainless Steel Mirror Frames - **Fifteen (15) years** - against corrosion.

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3. Tempered Glass Mirrors - **Five (5) years** - against silver spoilage.

4. Polished #8 Architectural Grade Finish on 304 Series Stainless Steel - **Two (2) years** against corrosion.

5. Bright Annealed Finish on 430 Series Stainless Steel - **Two (2) years** against corrosion.

Note: Warranty does not cover installation labor charges and does not apply to any units which have been damaged by accident, abuse, improper installation, improper maintenance, or altered in any way.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Catalog numbers used herein are Bradley Washroom Accessories, or approved equal. Refer to Drawings for schedule and additional information. Similar products for other indicated manufacturers will be acceptable.

B. Subject to compliance with requirements, manufacturers offering toilet accessories which may be incorporated in the work include one of the following:

1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Or approved equal

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gauge (.034") minimum, unless otherwise indicated.

B. Brass: Leaded and unleaded, flat products, FS QQ-B-613; Rods, shapes, forgings, and flat products with finished edges, FS QQ-B-626.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gauge (.040") minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirror Glass: ASTM C-1048, Type I, Class 1, Quality q2, 1/4" thick, with silver coating, copper protective coating, and non-metallic paint coating complying with A-A-3002 and ASTM C1503.

F. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

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2.3 PRODUCT DESCRIPTIONS

A. Mirror Units: #747 Series, Mirror plates shall be of No. 1 quality, silvered and electrolytically copper backed.

1. Frameless mirror with clip fasteners:
   a. Mirror: First quality ¼" float glass, thermosetting infrared-cured paint backing. Manufactured in accordance with ASTM C 1036 and ASTM C 1503. Edges ground and polished smooth.
   b. Mounting clips (metal) secured to wall with screws included, then engage mirror into clips.

2. Mirror units shall guaranteed by the manufacturer for a period of **fifteen (15) years** which starts on approved date of installation.

3. Size as indicated on Drawings.

B. Grab Bars: (Provide quantity and types indicated)

1. Stainless Steel Type: Provide grab bars with wall thickness not less than 18 (.050") gauge and as follows:
   a. Mounting: Concealed, manufacturer's standard flanges and anchorages.
   b. Clearance: 1-1/2" clearance between wall surface and inside face of bar.
   c. Gripping Surfaces: Manufacturer's non-slip texture.
   d. Heavy-Duty Size: Outside diameter of 1-1/2".

2.4 FABRICATION

A. General: No names or labels are permitted on exposed faces of toilet accessory units. On either the interior surface of the accessory or on the back surface, the manufacturer shall indicate the manufacturer’s information, model number on a printed waterproof label or a stamped nameplate attached to the accessory.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which work is to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 INSTALLATION

A. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

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B. Use all metal type fasteners such as anchors, plates, screws, bolts and expansion shields, type as required by the construction to which accessories are to be secured. Exposed hardware shall match finish of the accessory.

3.3 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

END OF SECTION 10800

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SECTION 11000 - GENERAL REQUIREMENTS - CASEWORK AND EQUIPMENT WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Part 1 through Part 6 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK

A. Casework and Equipment Work includes all items listed on schedules. All general requirements of this section apply to the Contract.

1.3 QUALITY ASSURANCE

A. Products of individual manufacturers are scheduled to establish type and standard of quality. Products of other manufacturers proposed to be used shall meet the published Specifications of the specified product as to materials, finishes, design and fabrication, to the satisfaction of the Architect.

B. Compatibility: Provide each type of equipment by a single manufacturer, including accessories. It is of the utmost importance that a stability of design and interchangeability of parts and pieces be provided, and it shall be specifically understood that a miscellaneous assortment of equipment assembled by dealers or agents will not be considered as meeting requirements of the Specification.

C. Casework and/or Equipment Work specified herein and other Division 11 Specification sections have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.

1. Comparable products of other manufacturers will be considered only if it can be clearly shown that their products are equal to or will exceed the construction quality requirements and other design attributes listed by manufacturers for indicated model numbers.

2. The General Contractor will not award Subcontract for Casework or Equipment supplier unless the Architect has approved that supplier’s samples, certificates, individual product Drawings, and proof of ability to perform.

1.4 SUBMITTALS

A. Submit manufacturer's technical data, catalog cuts and installation instructions for each type of equipment.

B. Samples: Submit, for verification purposes, samples of each exposed material from which equipment units and accessories are composed, in each color, finish, pattern and texture indicated. If these qualities are not indicated, submit, for initial selection, manufacturer's color charts or samples of actual materials showing full range of standard colors, finishes, patterns, and textures available. Include samples of the following:

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1. Baked enamel finishes for metal components
2. Wood and plywood materials and finishes
3. Molded plastic and fiberglass
4. Exposed fasteners

C. Submit full-size samples of finished units when complete with hardware, doors, adjustable shelves, etc., when requested by Architect. Acceptable sample units will be used for comparison inspection at project. Unless otherwise directed, acceptable sample units may be incorporated in the work. Notify Architect of their exact locations. If not incorporated in the work, retain acceptable sample units in the building until completion and acceptance of the work. Remove sample units from the premises when directed by Architect.

D. Shop Drawings

1. Submit shop drawings showing plans, elevations, ends cross-sections. Show details and location of anchorages and fitting to floors, walls and base. Include layout of units with relation to surrounding walls, doors, windows, and other building components.

2. Coordinate shop drawings with other work involved.

1.5 PRODUCT HANDLING

A. Deliver casework only after wet operations in building are complete.

B. Store completed equipment in ventilated place, protected from the weather, with relative humidity therein of 50% or less at 70°F.

C. Protect sanded and finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.6 JOB CONDITIONS

A. Advise Architect of requirements for maintaining heating, cooling and ventilation in installation areas as required to reach relative humidity necessary to maintain optimum moisture content.

B. Examination of Substrate and Conditions

1. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entry ways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a matter to permit it to be moved through properly into place.

2. Examine the substrate and the conditions under which the work under this section is to be performed, including condition of substrate to which equipment is to be attached, and notify the Architect, in writing, of unsatisfactory conditions Do not proceed with work under this section until satisfactory conditions have been corrected in an acceptable manner.

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1.7 QUALIFICATION OF SUPPLIERS OF CASEWORK AND EQUIPMENT

A. That it owns and operates a factory or factories adequate for and devoted to the manufacture of casework, equipment or material which is proposed to furnish and maintains strict inspection and quality control over the various manufacturing operations performed to produce a satisfactory end product of the standard and quality set forth in the detailed Specification.

1. That is at the time of submitting products and equipment and had been engaged in the manufacturing of casework or equipment for a recommended 10 consecutive years and has maintained during this time a published catalog of such specialized equipment, including a line similar to the specified.

2. That the manufacturer or their franchised representative shall have a major installation of equipment delivered and installed over a recommended 10 years conforming to the design and quality specified herein.

1.8 VARIATION FROM MATERIALS, PRODUCTS AND EQUIPMENT SPECIFIED

A. The designs, materials, finishes, functions and upholsteries have been selected by the Owner on the advise of the Architect with intention of creating an integrated building design. For this reason, no variations from the plans, Specifications and design guide will be permitted except as noted below.

1. Whenever and wherever in any of the Bid Documents an article, material or equipment is defined by describing a proprietary product or by using the statement, "as manufactured by", it is the intent that this shall describe by reference the materials desired; craftsmanship and method of manufacture, as well as the size and dimensions rather than detailing all of these requirements herein. It is not the intention to limit the bidding on such items, but merely to indicate that the item must conform to these standards.

2. **Any Laboratory Casework manufacturer requesting equivalence must submit test report from a Scientific Equipment and Furniture Association (SEFA) approved independent testing facility showing compliance with SEFA-8 standards. Failure to provide the required information maybe cause for rejection.**

PART 2 - PRODUCTS

2.1 See Schedules on Drawings.

2.2 GENERAL REQUIREMENTS (As applicable for each Contract)

A. BASIS OF DESIGN: CATALOG NUMBERS REFER TO CAMPBELL-RHEA CASEWORK CATALOG, ETC.; OR APPROVED EQUAL, UNLESS OTHERWISE SHOWN, SEE PARAGRAPH 1.2 ABOVE.

B. ALL CASEWORK DOORS AND DRAWERS TO HAVE LOCKS KEYED ALIKE PER ROOM AND MASTER KEYED.

1. The Contractor shall package keys for each room separately and identify the room number on the package and deliver to the Owner's Representative.

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C. ALL TOPS SHALL BE 3/4" PLYWOOD WITH SOLID SURFACE COVERING ON ALL EXPOSED SURFACES (UNLESS NOTED OTHERWISE).

D. ALL BACKSPLASHES SHALL BE SOLID SURFACE SECURED TO THE WALL SURFACE (UNLESS NOTED OTHERWISE).

E. ALL FURNITURE, CASEWORK AND EQUIPMENT SHOWN DOTTED AND/OR IS INDICATED AS (N.I.C.) IS NOT IN CONTRACT.

F. UNLESS OTHERWISE SHOWN, THE CASEWORK AND EQUIPMENT WORK SUBCONTRACTOR SHALL SUPPLY AND DELIVER ALL SINKS, TAILPIECES, FAUCETS AND STRAINERS, IN CASEWORK TO THE PLUMBING AND DRAINAGE WORK SUBCONTRACTOR.

1. PLUMBING SUBCONTRACTOR SHALL SUPPLY AND INSTALL ALL TRAPS, VALVES ETC AND SHALL MAKE FINAL CONNECTIONS TO ALL WASTE/VENTS AND WATER LINES, ETC., AS REQUIRED, TO MAKE SYSTEMS FULLY FUNCTIONAL.

2. UNLESS OTHERWISE SHOWN, CASEWORK AND EQUIPMENT SUBCONTRACTOR SHALL MAKE SINK CUT-OUTS.

3. SINK CABINETS TO BE INSTALLED BEFORE THE INSTALLATION OF ADJACENT CABINETS.

G. ALL (SUB)CONTRACTORS TO FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO CONSTRUCTION AND NOTIFY CONSTRUCTION MANAGER AND ARCHITECT IN WRITTEN FORM OF ANY DISCREPANCIES.

H. PROVIDE ALL FILLERS, AS REQUIRED. FINISH TO MATCH CASEWORK.

I. UNLESS OTHERWISE SHOWN, RUBBER BASE ON ALL CASEWORK BY G.C.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.2 INSTALLATION

A. Deliver, uncrate, set in place and install plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes in corners.

B. Trim and Moldings: Install in single, unjointed lengths for openings and for runs less than maximum length of lumber available. For longer runs, use only one piece less than maximum length available in any straight run. Stagger joints in adjacent members.

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C. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

D. Inspect for dents, scratches, stains, holes, etc. Replace any items showing damage, loose joints or other defects.

3.3 CLEANING AND PROTECTION

A. Clean and polish all items, remove packing cases and debris from the site.

B. Protection: Perform all procedures and precautions for protection of materials and installed casework from damage by the work of other trades until acceptance of the work by the Owner.

C. Cover casework with 4-mil polyethylene film for protection against soiling and deterioration during remainder of construction period.

END OF SECTION 11000

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SECTION 11011 - CASEWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Section Includes: Wood Casework and related equipment.

1. Pre-manufactured wood casework and equipment, covered by this Specification and accompanying Drawings, are manufactured or supplied by one manufacturer to avoid divided responsibility.

B. Work included in this section:

1. Furnish all items of equipment as listed in the Specifications, equipment schedule and/or as shown on the Drawings, including delivery to the building, unpacking, setting in place, leveling, and scribing to walls and floors, as required.

2. **Furnishing:** Equipment Subcontractor shall make cutouts, holes and openings in countertops so as to be ready for installation of fixtures by the Plumbing Work Subcontractor.
   a. The Casework and Equipment Subcontractor(s) shall turn over to the Plumbing Subcontractor in a package, all sinks, fixtures, faucets, tailpieces, strainers, etc., and nipples and locknuts, etc., for installation and final connection by the Plumbing Subcontractor.

3. The Casework and Equipment Subcontractor shall provide an itemized lists and a designated site location for the transfer of the above referenced materials to the Plumbing Subcontractor. The list shall have a description of the items and quantity along with a sign-off line for the Plumbing Subcontractor.
   a. A copy of the signed list is to be submitted to the Architect/Owner prior to billing for this equipment.

4. All debris, dirt and rubbish accumulated as a result of this installation shall be removed and the premises left clean and orderly.

5. All (Sub)Contractors shall familiarize themselves with the job conditions and building measurements in order to coordinate the planning, design, connections, delivery and erection of the fixed casework and related equipment furnished under these Specifications with other related and associated work during the term of the Contract.

C. Work included under the work of other Trades:

1. The **connection** of sinks, tailpieces, traps, service lines, drain lines, and piping within the equipment and through, under or along the backs of working surfaces as required by the Specifications and/or as shown on the Drawing shall be by the Plumbing and Drainage Work Subcontractor in accordance with Part-4 Specifications Sections.

2. The furnishing of any framing or reinforcements for walls, floors, or ceilings to support any equipment, General Construction Work Contractor in accordance with Part-2 Specifications Sections.

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1.2 QUALITY ASSURANCE

A. Provide all casework (for integration with tops, sinks and service fixtures, as required) manufactured or furnished by the same company for single responsibility.

B. Basis of Design: **"Campbell Rhea - Classic Oak Series", as manufactured by Institutional Casework, Inc.**; or approved equal.

C. Products specified herein have been selected because of their quality of construction, configuration, design, function, available finishes, components, accessories, dimensions, shape and style.

1. Comparable products of the following manufacturers will be considered if it can be clearly shown that their products are equal to or will exceed the construction quality requirements and other design attributes listed above.
   a. Diversified Casework.
   b. Leonard Peterson - Vanguard Line, Lipped.
   c. TMI Systems Design Corp.
   d. Or approved equal.

2. The use of one manufacturer's catalog numbers, and the specific requirements set forth in Drawings and Specifications, are not intended to preclude the use of other manufacturer's products or procedures which may be equivalent, but are given for the purpose of establishing a standard of design and quality for materials, construction and workmanship.

3. Substitute products will be considered for substitution only when submitted to the Architect as per the requirements of AIA A232 and Section 00800.

4. Substituted product(s) shall be meet the following minimum requirements:
   a. All four corners of drawer boxes must be dove-tailed together, and the bottom of all drawer boxes must be let in to the sides, front and back, to be “fully captured.” Applied drawer bottoms will not be permitted.
   b. All drawer front shall be fabricated from solid red oak lumber.
   c. All cabinet doors shall be framed with solid oak rails on four sides. Tall case doors shall include a lightweight core to reduce stress on hinges. Doors constructed of plywood or particleboard, edge-banded with oak will not be permitted. Tall case doors shall be mounted with (4) hinges.
   d. All tall case doors shall be complete with three-point latching mechanism. Single-point latching will not be permitted.

5. The General Contractor will not award Subcontract to a wood laboratory casework supplier who is not on the approved list, unless the Architect has approved that supplier’s samples, certificates, individual product Drawings, and proof of ability to perform.

1.3 SUBMITTALS

A. Submit two copies of manufacturer's data and installation instructions for each type of equipment.

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B. Samples:

1. Submit samples of available solid surface colors for Architect's selection.

2. Submit one full size sample of finished base cabinet unit complete with hardware, doors and drawers, without finish top.

3. Submit one full size sample of finished wall mounted cabinet unit complete with hardware, doors and adjustable shelves.

4. Acceptable sample units will be used for comparison inspections at project. Unless otherwise directed, acceptable sample units may be incorporated in the work. Notify Architect of their exact locations. If not incorporated in the work, retain acceptable sample units in the building until completion and acceptance of the work.

5. Remove sample units from the premises when directed by the Architect.

C. Shop Drawings

1. Submit shop drawings showing plans, elevations, ends, cross-sections, service run spaces, locations and type of service fixtures with lines thereto. Show details and location of anchorages and fitting to floors, walls and base. Include layout of units with relation to surrounding walls, doors, windows, and other building components.

2. Coordinate shop drawings with other work involved.

D. **Test Reports - Certifications:**

1. Submit the following:
   a. Test reports certifying that the casework finish complies with chemical and other resistance requirements of the Specifications.
   b. Performance test reports from an independent testing lab on each specified top material.

1.4 PRODUCT HANDLING

A. Deliver casework only after wet operations in building are complete.

B. Store completed wood furniture in ventilated place, protected from the weather, with relative humidity therein of 50% or less at 70°F.

C. Protect sanded and finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.5 JOB CONDITIONS

A. Advise Architect of requirements for maintaining heating, cooling and ventilation in installation areas as required to reach relative humidity necessary to maintain optimum moisture content.

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B. Examination of Substrate and Conditions

1. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entry ways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a matter to permit it to be moved through properly into place.

2. Examine the substrate and the conditions under which the work under this section is to be performed, and notify the Architect, in writing, of unsatisfactory conditions. Do not proceed with work under this section until satisfactory conditions have been corrected in an acceptable manner.

1.6 WARRANTY

A. Manufacturer shall warrant the casework to be free from defects in materials and workmanship, under normal use and service, for **three (3) years** from date of delivery.

1. Within the warranty period, manufacturer shall repair, replace, or refund the purchase price of defective casework.

PART 2 - PRODUCTS

2.1 GENERAL

A. The best cabinet making practices for casework construction shall be followed. All cabinets shall be integral units, each completely enclosed without the use of common partitions unless otherwise specified.

2.2 MATERIALS

A. Lumber:

1. Oak lumber is red oak, grade FAS or better, air dried and kiln dried to a 6 percent moisture content, then tempered to 7-8 percent prior to fabrication. Red oak lumber exposed to view, is free of stains, splits, shakes, season checks and other similar defects.

2. Other hardwoods are grade FAS or better, air dried to a 6 percent moisture content, then tempered to 7-8 percent prior to fabrication. Other hardwoods are used in semi-exposed, or unexposed, areas and comply with NHLA grading for FAS or better lumber.

B. Plywood:

1. Oak plywood is red oak, grade A-2, plain sliced, book-matched, crossbanded, and has a solid core.
   a. 3/4 inch is a minimum of 7-ply.
   b. ½ inch is a minimum of 5-ply.
   c. 1/4 inch is a minimum of 3-ply.
   d. 3/32 inch is a minimum of 3-ply.

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2. Other hardwood plywoods are sound grade, have a solid core and are suitable for semi-exposed or unexposed areas.
    a. 3/4 inch is a minimum of 7-ply.
    b. ½ inch is a minimum of 5-ply.
    c. 1/4 inch is a minimum of 3-ply.
    d. 3/32 inch is a minimum of 3-ply.

C. Hardboard:

1. Hardboard is service tempered and consists of steam-exploded wood fibers, highly compressed into a hard, dense, 1/4 inch thick, homogeneous sheet, using natural resins and other added binders.

2. Physical properties:
    a. Average modulus of rupture is 5,300 lbs./sq. inch
    b. Density is 50 to 60 lbs./cu. foot
    c. Tensile strength of 3,500 lbs./sq. inch.

D. Particleboard:

1. Particleboard is industrial grade.

2. Physical properties:
    a. Density, 46 to 50 lbs./cu. ft.
    b. Modulus of rupture, minimum, 2,200 psi
    c. Modulus of elasticity, minimum, 450,000 psi.

E. Service Fixtures:

1. Water or other services: Triple chrome plated, have heavy-duty construction and are specifically designed for laboratory use.
    a. **Water Faucets - Hot and Cold:** Faucets are cast from red brass, and have four-arm type handles with color coded indexes. Faucets have serrated hose nozzles. Faucets have patented REX unit ceramic disc cartridges, and replaceable seats. The stem is brass, with full Acme threads, and has a brass cap nut. Goosenecks are rigid. Fixture outlets are tapped 3/8 inch I.P.S. for aerators, vacuum breakers, hose connections, and or other accessories. Provide vacuum breakers.
        (1) Provide lever handle type faucet control for barrier free applications in accordance with sink notes indicated on Drawings.
    b. **Vacuum Breakers:** Watts NLF-9, or comparable, vacuum breakers are brass with polished chrome plating, screw-in type with stainless steel working parts, and durable rubber diaphragm and disc. Vacuum breaker is for hot or cold faucet and has a primary valve with a soft disc that seats against mating part. The secondary check valve utilizes a soft disc to metal seating. Breaker is tapped 3/8 inch N.P.T.

2. Sinks and Sink Outlets:
    a. **Stainless steel** sinks have a satin finish. They are 18 gauge, type 304, 18-8 stainless steel, with heavily undercoated bottoms and positive pitch drains. Outlets are chrome plated brass. Drain holes are 3-1/2 inch diameter for 4-1/2 inch stainless steel cup strainers. The cup strainer has a neoprene stopper. Provide necessary tail pieces to tie into plumbing roughing, typical.

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NOTE: Coordinate with Plumbing Drawings and Specifications.

G. Tops (See Equipment Schedule):

1. Solid Polymer Fabrications (Solid Surface)
   a Refer to Section 06650.

H. Hardware and Accessories:

1. Pulls: Shall be selected by the Architect from manufacturer's available standard and custom units at no additional cost to the Owner.

2. Handles:
   a. Latching handle LH-1 is die cast zinc alloy, 4-1/4 inches long, has a dull chrome plated finish. Handle operates with 1/4 turn. Double door cases have latching handles on the right door and dummy handles on the left door. The rods are 5/16 inch in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate which engages the side of the case, or latches behind the left door on cases with double doors.
   b. Locking handle LK-1 is a latching handle with a lock mechanism incorporated into the handle head. On double door cases, the left door has a dummy handle, and the right door has the locking handle. Lock is laboratory grade with a 5-disc tumbler mechanism and a dull chrome plated face. Tumblers and keys are brass, while the plug and cylinder are die cast zinc alloy.

3. Locks:
   a. Lock SL-1 is a laboratory grade, cylinder cam lock, with a 5-disc tumbler mechanism, and a dull chrome plated face. Tumblers and keys are brass, while plug and cylinder are die cast zinc alloy. Lock operates with a 180 degree turn of the key. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock.
   b. Locks are to be furnished on all doors and drawers.

4. Hinges:
   a. Hinge CP-1 is heavy duty, institutional type, 5-knuckle hospital tipped, and made from .095 inch thick, chrome plated mild steel. Hinge is wrap around style, and 2-3/4 inches high. The wing for mounting to end panel has 4 holes, two of which are slotted for adjustability; wing for the door has 5 holes, two of which are slotted for adjustability.
   b. Elbow catch is a steel, spring loaded catch that releases with finger pressure. The catch and steel strike plate are mounted with screws. Strike plate screw holes are slotted for adjustability and pin hole is provided to help anchor its position.

5. Drawer Slides:
   a. Drawer slides DS-1 are electrostatically epoxy powder coated, cold rolled steel, heavy-duty, side mounted, and have a 150 lb. load capacity. They are equipped with heavy-duty, ball bearing nylon rollers for smooth effortless operation. Slides have automatic positive stop levers to prevent accidental drawer removal, but allow quick removal without tools.
   b. File drawer slides FD-1 are zinc plated, cold rolled steel, heavy-duty, side mounted, and have a 100 lb. load capacity. They are equipped with heavy-duty, ball bearing nylon rollers. Slides are full extension with a positive stop, and a lift out disconnect.

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6. Shelf Clips:
    a. **Shelf support clips shall be "seismic" twin pin type for mounting on interior of cabinet work. Clips shall be corrosion resistant and shall retain shelves from accidental removal. Shelves in all cabinets are adjustable on 32mm centers.**
        1) Single pin support clips and surface mounted metal support strips and clips subject to corrosion are not acceptable.

2.3 FABRICATION

A. Factory assembly of casework in the largest components possible aids in the installation. Mortise and tenon construction with glued and screwed joints is used for maximum strength; and the use of precision jigs and clamps ensures square corners and plumb vertical surfaces.

B. Fabrication of laboratory casework and equipment is completed to dimensions in the final, approved copy of shop drawings.

C. Base Cabinets:

1. All base cabinets are rigidly constructed, integral units with the strongest most advanced joinery methods utilized of bored, doweled, dadoed, glued and screwed construction. Each base cabinet is completely enclosed without the use of common partitions, and has flush construction with overlapping doors and drawers, which provides a dust resistant interior. A base cabinet has a full horizontal top frame with bored, doweled and glued joints, intermediate front rails and a 3/4 inch plywood bottom; rear horizontal parting rails and separators are provided as required. Horizontal top frame, intermediate parting rails and the bottom are bored, doweled and glued. Separators where indicated, are let into routed intermediate rails. Backs are recessed and encapsulated into dadoed end panels and further secured with glue blocks on each side, except where they need to be removable for access to plumbing. Backs are screwed to the top frame and further secured with glue blocks on each side. An enclosed toe space, 2-1/4 inches by 4 inches, is furnished with the toe rail bored, doweled and glued to end panels.

D. Wall and Upper Cases:

1. All wall and upper cases are rigidly constructed, integral units with the strongest most advanced joinery methods utilized of bored, doweled, dadoed, glued and screwed construction. Each case is completely enclosed without the use of common partitions, and has flush construction with overlapping doors, which provides a dust resistant interior. Top panel is bored, doweled and glued into end panels. Bottom panel is bored, doweled and glued into end panels; and glued and screwed to the back. Backs are recessed and encapsulated into dadoed end panels, and further secured with glue blocks on each side. Exterior hanger rails, at the top of the back, are glued to the back and then screwed to the top panel and bored, doweled and glued into end panels. Exterior hanger rails, at the bottom of the back, are glued to the back and then screwed to the bottom panel and bored, doweled and glued into end panels. Adjustable shelves are supported on **"seismic" twin pin type** shelf clips, which fit into holes drilled 32 mm on centers, in the case end panels.

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E. Tall Cases:

1. All tall cases are rigidly constructed, integral units with the strongest most advanced joinery methods utilized of bored, doweled, dadoed, glued and screwed construction. Each case is completely enclosed without the use of common partitions, and has flush construction with overlapping doors, which provides a dust resistant interior. Top panel is bored, doweled and glued into end panels. Bottom panel is bored, doweled and glued into end panels and glued and screwed to the back. An exterior back cross rail is provided at the top of each case, glued to the back, and then screwed to the top panel and bored, doweled and glued into the end panels. Additional back cross rails are provided, as required. Backs are recessed, let into dadoed end panels, and further secured with glue blocks at the sides. An enclosed toe space, 2-1/4 inches by 4 inches high, is furnished with toe rail securely bored, doweled and glued to end panels and bottom panel.

2. Rails:
   a. Interior: 2-1/4 inches by 3/4 inch, solid hardwood
   b. Exterior: 4-1/8 inches by 3/4 inch, solid oak

3. Top panel, bottom panel, dividers, fixed shelf and adjustable shelves:
   a. Cases with exposed interiors: All are 1 inch oak plywood
   b. Cases with unexposed interiors: All are 1 inch hardwood plywood.

4. Backs:
   a. Cases with exposed interiors and exposed exteriors: Back is 1/4 inch oak plywood.
   b. Cases with unexposed interiors and unexposed exteriors: Back is 1/4 inch service tempered hardboard.

5. End panels:
   a. Cases with exposed interiors: End panels are 3/4 inch oak plywood.
   b. Cases with exposed exteriors: end panels are 3/4 inch oak plywood.
   c. Cases with unexposed interiors and one exposed end panel and one unexposed end panel: Exposed end panel is 3/4 inch oak plywood; unexposed end panel is 3/4 inch hardwood plywood.
   d. Cases with unexposed interiors and unexposed exteriors: end panels are 3/4 inch hardwood plywood.

6. Exposed edges of end panels, dividers and shelves are edge-banded with 1/4 inch solid oak.

7. Exterior back cross rails: 3 inches by 3/4 inch hardwood plywood.

F. Drawers:

1. Components:
   a. Drawer front: 13/16 inch oak lumber.
   b. Drawer sides and back: ½ inch hardwood lumber.
   c. Drawer bottom: 1/4 inch service tempered hardboard.
   d. Construction: All four corners of the drawer are dovetailed and glued. Edges of the drawer front are machine radiused to form a lip and overlap the opening 1/4 inch on all sides. Drawer fronts are one piece of lumber, providing consistency in color

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and grain within each drawer front. The back perimeter of the drawer front is routed so drawer front is recessed into the opening and projects 13/32 of an inch. The top edge of drawer sides and back are radiused. The bottom is let into the box on four sides and securely glued underneath with a continuous bead of glue around the perimeter of the drawer bottom. In cabinets 24 inches or less in width, drawers have one, AL-1aluminum pull which is surface mounted with 2 screws, 4 inches on centers. In cabinets over 24 inches wide, drawers have two AL-1 aluminum pulls. Drawers are supported on DS-1 slides which are side mounted, heavy duty, electrostatically epoxy powder coated, cold rolled steel, and have a 150 lb. load capacity. Slides are equipped with heavy-duty, ball bearing nylon rollers for smooth effortless operation. DS-1 slides have automatic, positive stop levers to prevent drawer's accidental removal, but allow for quick removal without tools. File drawers are supported on side mounted FD-1 full extension steel slides. File drawers have an interior, screw mounted, metal bottom track and an adjustable metal file follower. Lock SL-1 is furnished when indicated.

G. Doors:

1. Hinged solid doors, 48 inches or less in height:
   a. Core ply: Solid oak rails on four edges framing a particleboard core.
   b. Hardwood plywood crossbands: Four; two laminated on each side of core ply.
   c. Red oak veneer: Face plys; one applied to each side.
   d. Construction: Hinged solid doors, 48 inches or less in height, are 13/16 inch thick and have solid oak rails on the four edges. Doors overlap the opening 1/4 inch on all sides and have machined radiused edges. Doors have one aluminum pull which is surface mounted with two screws. Doors have two, CP-1 chrome plated, heavy duty, institutional type, 5-knuckle hospital tipped hinges, each attached with 5 tempered steel screws into solid oak framing of door, and 4 Euro screws into the end panel. Doors are secured by zinc plated steel, friction roller catches, with positive action, spring cushioned, polyethylene roller, and a metal strike plate. Catch and steel strike plate are attached with screws. On lockable double door cabinets, the left door is secured with a steel, spring loaded, elbow catch that releases with finger pressure. The catch and the strike plate are attached with screws. Strike plate screw holes are slotted for adjustability and a pin hole is provided to help anchor plate's position. Lock SL-1 is furnished when indicated.

2. Hinged solid doors over 48 inches in height:
   a. Core ply: Solid oak rails on four edges framing a particleboard core.
   b. Hardwood plywood crossbands: Four; two laminated on each side of core ply.
   c. Red oak veneer: Face plys; one applied to each side.
   d. Construction: Hinged solid doors over 48 inches in height, are one inch thick and have solid oak rails on the four edges. Doors overlap opening 1/4 inch on all sides, and machined radiused edges. Single doors and right door of double doors have a LH-1 latching handle, which is 4-1/4 inches long, streamline design, with a dull chrome plated finish. Handle operates with 1/4 turn. Left door of double doors has a fixed handle, which is the same size and finish as a LH-1 latching handle. A three point latching system provides single doors and right door of double doors positive engagement at the top and bottom of the door with tapered aluminum rods which engage plastic strike plates and pull the door snug. The rods are 5/16 inch in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate which engages the side of the case, or

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latches behind the left door on cases with double doors. Right door of double doors lap over the integral machined astragal on left door, securely holding door shut. Doors have three, CP-1 chrome plated, heavy duty, institutional type, 5-knuckle hospital tipped hinges; each attached with 5 tempered steel screws in to solid oak framing of the door, and 4 Euro screws into the end panel. Left door of double doors is additionally secured with two zinc plated steel, friction roller catches, with positive action, spring cushioned, polyethylene roller, and a metal strike plate. Catches and steel strike plates are attached with screws. Catch screw holes are slotted for adjustability, and the strike plate has two nips to help anchor its position. Locking handle LK-1 is furnished when indicated.

H. Casework Finishes:

1. Surfaces to be Finished: Exposed exterior and exposed interior surfaces of cabinets receive the full finishing process. The unexposed interior surfaces of cupboards, drawers, wall cases, upper cases, and tall cases receive a baked on protective coat of moisture and chemical resistant catalyzed sealer, and a top coat of clear, catalyzed conversion varnish. Other unexposed surfaces are processed through standard finishing steps, and receive a baked on protective coat of moisture and chemical resistant catalyzed sealer.

2. Finishing Process: Prior to assembly lumber for doors, drawers and cabinets, and plywood for cabinets, are machine sanded with 120 grit, 180 grit, and finally, 220 grit sand paper. Flat surfaces receive two additional machine sandings: one in an orbital crossbelt sander with 40 micron and 60 micron grit sanding belts; and, one through a rotary polisher with 150 grit sand paper. Door and drawer front edges are machine sanded to a very smooth surface through a profile edge sander utilizing a 100 grit and a 150 grit paper. After assembly, drawers, doors, and casework are thoroughly examined and fine-finished by hand to provide a consistently smooth surface. Prior to the first application in the finishing process, items are placed in the dust-off booth where compressed air is used to remove loose fibers and dust. Selected surfaces are stained with NGR stain to the desired color and allowed to dry. Next a protective coat of moisture and chemical resistant, catalyzed sealer is applied. After flash drying, items are oven baked at 130°F. Following a cool down period, surfaces that receive the final top coat are carefully hand sanded and wiped clean. A top coat of clear, catalyzed, conversion varnish is applied, allowed to dry, and then oven baked at 130°F. The final top coat provides chemical resistance, toughness, durability, and excellent color stability with a smooth finish and high-gloss lustre.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition casework and furniture to average prevailing humidity conditions in installation areas prior to installing.

3.2 INSTALLATION

A. Install plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners. Install wall cabinets in accordance with details on Drawings.

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B. Trim and Moldings: Install in single, unjointed lengths for openings and for runs less than maximum length of lumber available. For longer runs, use only one piece less than maximum length available in any straight run. Stagger joints in adjacent members.

C. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed upon completion of installation.

B. Protection: Perform all procedures and precautions for protection of materials and installed casework from damage by the work of other trades until acceptance of the work by the Owner. Advise HVAC Subcontractor of the required temperature/humidity conditions which must be maintained during the remainder of the construction period.

C. Cover casework with 4-mil polyethylene film for protection against soiling and deterioration during remainder of construction period.

D. Clean up cut out pieces, sawdust and debris, packing cases, etc. Leave areas in broom clean condition. Remove all debris as a result of work of the Contract.

END OF SECTION 11011

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SECTION 12500 - WINDOW TREATMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Drawings and conditions of the construction Contract, including but not limited to construction General Conditions, the Supplementary Conditions, and all Division 1 - General Requirements specifications sections, apply to work of this section.

B. The extent of window treatment is indicated on Drawings. Type of window treatment work in this section includes:

1. Chain operated, manual window shades, translucent shadecloth material and valances at all spaces, as indicated on the Drawings.

1.2 QUALITY ASSURANCE

A. General: Provide window treatment units which are complete assemblies produced by one manufacturer for each type required, including hardware, accessory items, mounting brackets, and fastenings.

B. Manufacturer / Installer: Provide shades by a single manufacturer with a recommended minimum of ten (10) years' experience with the specified products herein. All work to be erected by skilled workers especially trained in this type of work with and with a recommended minimum ten (10) years' documented experience, by the manufacturer or their authorized representatives.

C. Fire-Performance Characteristics: Provide shade material tested in accordance with NFPA 701 - Vertical-Burn Test and rated "PASS".

D. Toxicity Report: Provide report on toxicity characteristics, in accordance with New York State toxicity laws.

E. Resistance to Microorganisms: Provide shade material tested in accordance with ASTM tests G-22-80 and G-21-85. All results must show no growth. Resistance must be inherent and for the life of the shadecloth. Topically treated shadecloths will not be accepted.

F. Field Measurements: Contractor / installer shall take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of window shade system. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay required installation schedules.

G. Furnish materials in colors and patterns as indicated, or, if not indicated, as selected by Architect from manufacturer's standard colors/patterns.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for the/each type of window treatment unit required. Include methods of installation for each type of opening and supporting structure.

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B. Shop Drawings: Submit shop drawings for special components and application conditions of window treatment units which are not fully dimensioned or detailed in manufacturer's product data. Show relationships to adjoining work.

1. Include typical elevation layout indicating proposed division between blind units and meeting edges at corners. Provide sections and details at head and sill between blind units and corners including inclined installations.

2. Provide schedule of all units to be furnished, including field measurements at each location.

3. Provide locations of chain drives, when applicable.

C. Samples

1. For initial selection of colors, submit manufacturer's color charts consisting of sections of exposed components with integral or applied finishes showing full range of colors, materials, etc. available for each type of window treatment assembly required.

2. For verification purposes, submit samples of each component, material and finish which will be exposed to view, for each type of window treatment required. Prepare samples from same materials to be used for the work.
   a. In addition, submit one complete small-size operating unit for each type of window treatment required.

D. Certificate of Compliance: Manufacturer shall submit notarized certificate of compliance indicating compliance with requirements of Specifications including statement that specified warranty will be provided without restriction.

1. Manufacturer shall certify that materials proposed for use comply with applicable building code and environmental regulations.

E. Maintenance 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 Typical Window Treatment Units: Furnish cloth fabric and chain units in the following quantities:
   a. Shade Cloth Fabric: One Unit for each size indicated.
   b. Chain Units: One unit for each indicated opening.

1.4 WARRANTY

A. Roller Shade Hardware Warranty: Manufacturer's standard non-depreciating **twenty-five (25) year limited** warranty.

B. Standard Shadecloth: Manufacturer's standard **twenty-five (25) year** warranty.

C. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating **five (5) year** warranty.

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D. Roller Shade Installation: **Two (2) years** from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed Owner's responsibility.

PART 2 - PRODUCTS

2.1 WINDOW SHADES

A. Provide window shades for indicated windows, as indicated on Drawings. Shades shall be shadecloth shades, complete with fully enclosed head box, side channels of extruded aluminum and bottom rail.

B. Provide manually operated shades, as manufactured by MechoShade Systems, Inc.; or approved equal.

C. Shade Type and Product Line:

1. The Drawings and Specifications indicate the minimum clearances and performance requirements of the following shade type, product line and manufacturer that establish the quality standards required.
   a. Roller Shade Type:
      1) Manual Single Shades: (Shadecloth)
         a) Product Line: MechoShade 5: totally integrated manual operating chain and sprocket driven roller shades.
         b) Shade to be provided in static mode with infinite number of stop positions.
         c) Shades to be Regular Roll (fabric shall roll toward window) and chain offset to rear of drive bracket toward window. Non-offset shades will not be accepted.
         d) There shall be upper and lower stop limits to prevent over-winding and unrolling to ensure alignment and air clearance at the sill.

D. Manual Shade Brackets:

1. All hardware shall be provided with regular and offset drive capacity, and shall be reversible for left or right hand operation.

2. Shade hardware shall allow shade roller to be removed from brackets and / or opening without requiring brackets to be removed.

3. Shade hardware shall allow for field adjustment of drive / brake mechanism or replacement of any operable hardware component without requiring removal of brackets regardless of mounting position.

4. Mounting brackets shall allow Snap-Loc Fascia to run continuously across multiple shades.

5. Drive Chain shall be #10 qualified stainless steel chain rated to 90-pound minimum breaking strength.

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E. Mounting Systems:

1. Shade mounting system shall consist of extruded 6063-T6 aluminum tube sized to support spans shown with asymmetrically shaped channels in which a matching snap-in vinyl spline shall be mounted.

2. The shade and spline shall be removable and replaceable without disassembling the hardware.
   a. Slide-on-spline, glue, tape and or staples as a means for mounting shadecloth to the roller tube will not be acceptable.

3. The tube end-plug and pin assembly shall have a recessed end which fits over the idle-end support providing a minimum of 6mm lateral tube clearance and no more than 6 mm shade-cloth side clearance and 143 mm edge clearance on the drive-end side. The idle-end pin shall be laterally adjustable 8 mm.

F. Snap-loc Fascia:

1. At all shade locations provide extruded aluminum Snap-loc fascia, which continuously fits on the end and center brackets as a one-piece section over two or more shade bands.

2. Fascias shall be provided in a maximum extrusion length of 15’-0” to cover multiple shade bands where possible.

3. Aluminum parts shall be matching the aluminum window / storefront framing system.

G. Chain Placement: Shall be offset to rear of drive brackets toward the window.

H. Shadecloth:

1. Fabric shall be sufficiently heat-set so that edges do not ravel when knife cut.

2. Shade Fabrication:
   a. Shades shall be fabricated square with a snap-Loc spline for fastening directly to mounting tube.
   b. A weighted hembar shall be sealed within the hem with all edges sealed; cutting shall be by means of an edge-sealing hot-knife system.

3. Cloth:
   a. Single-Fabric Shadecloth: MechoShade Systems, Inc., "ThermoVeil Basket Weaves 1300 Series"; or approved equal, 5% Openness, 75% PVC Coating, 25% Polyester, in colors as selected by the Architect from manufacturer's available full range of colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and conditions for installation.

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B. Notify the Architect in writing prior to beginning of installation when the project conditions are unacceptable for shade installation.

1. "Beginning of installation" means acceptance of substrate and project conditions.

2. Do not commence installation until conditions are satisfactory.

3. Commencement of installation indicates acceptance of site conditions by Contractor.

3.2 INSTALLATION

A. Install units to comply with the Manufacturer's instructions for the type of mounting and operation required. Provide units plumb, true, and securely anchored in place with recommended hardware and accessories to provide smooth operation without binding.

B. Install units within the following tolerances:

1. Maximum variation of gap at window opening perimeter: 1/4 inch, per 8 feet (+/- 1/8 inch) of shade height.

2. Maximum offset from level: 1/8 inch per 5 feet of shade width.

C. Isolate metal parts from concrete and mortar to prevent galvanic action. Use tape or thick coating or other means recommended by manufacturer to effect separation.

3.3 ADJUSTMENTS

A. Adjust drive / brake mechanism of units for smooth operation. Adjust shade and shadecloth to hang flat without buckling or distortion. Replace any units or components that do not hang properly or operate smoothly.

3.4 CLEANING AND PROTECTION

A. Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.

B. Clean exposed surfaces, including metal and shadecloth, using non-abrasive materials and methods recommended by the Shadecloth Manufacturer. Remove and replace work, which cannot be satisfactorily cleaned.

C. Protect installed units to ensure their being in operating condition, without damage, blemishes, or indication of use at completion of project. Repair or replace damaged units, as directed by Architect.

3.5 DEMONSTRATION

A. Demonstrate operation method and instruct Owner's personnel in the proper operation and maintenance of the window shade system.

END OF SECTION 12500

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PART 4 - FIRE SUPPRESSION

SECTION 13390 – WET PIPE FIRE SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Pressure gages.

1.03 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

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.

1.05 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive Engineering analysis by a qualified professional Engineer, using performance requirements and design criteria indicated.

a. Contractor shall arrange and pay all fees associated with a fire hydrant flow test to be used in the design of the fire sprinkler system. Provide copy of test to Architect.

C. 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. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    b. General Storage Areas: Ordinary Hazard, Group 1.
    c. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    d. Office and Public Areas: Light Hazard.
    e. Classrooms : Light Hazard
    f. Corridors : Light Hazard
    g. Conference Rooms : Light Hazard
    h. Gallery : Light Hazard

3. Minimum Density for Automatic-Sprinkler Piping Design:

4. Maximum Protection Area per Sprinkler: Per UL listing.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

    a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and SCE/SEI 7.

1.06 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

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. Coordination Drawings: Sprinkler systems, 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.
2. HVAC hydronic piping.
3. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

E. Qualification Data: For qualified Installer and professional Engineer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. 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."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 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. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.08 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.09 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.01 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.

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Galvanized- and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Galvanized- and Uncoated, Steel Couplings: ASTM A 865, threaded.

E. Galvanized- and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Tyco Fire & Building Products LP.

c. Victaulic Company.
d. Or approved equal.

2. Pressure Rating: 175 psig minimum.
3. Galvanized- and Uncoated, 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.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Anvil International, Inc.
b. Victaulic Company.
c. Or approved equal.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Fivalco Inc.
    b. Global Safety Products, Inc.
    c. Milwaukee Valve Company.
    d. Or approved equal.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Kennedy Valve; a division of McWane, Inc.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Pratt, Henry Company.
    f. Shurjoint Piping Products.
    g. Or approved equal.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Clow Valve Company; a division of McWane, Inc.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. Kennedy Valve; a division of McWane, Inc.
    g. Metraflex, Inc.
    h. Milwaukee Valve Company.
    i. Mueller Co.; Water Products Division.
    j. NIBCO INC.
    k. Potter Roemer.
    l. Reliable Automatic Sprinkler Co., Inc.

m. Tyco Fire & Building Products LP.
n. United Brass Works, Inc.
o. Venus Fire Protection Ltd.
p. Victaulic Company.
q. Viking Corporation.
r. Watts Water Technologies, Inc.
s. 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.

F. 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. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.
o. 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.

G. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Global Safety Products, Inc.
d. Kennedy Valve; a division of McWane, Inc.

e. Milwaukee Valve Company.
f. NIBCO INC.
g. Shurjoint Piping Products.
h. Tyco Fire & Building Products LP.
i. Victaulic Company.
j. 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, two-circuit, supervisory switch indicating device.

2.05 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. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.
c. Or approved equal.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Affiliated Distributors.
b. Anvil International, Inc.
c. Barnett.

d. Conbraco Industries, Inc.; Apollo Valves.
e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.
w. Or approved equal.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.
c. Or approved equal.

E. Plug Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Southern Manufacturing Group.
b. Or approved equal.

2.06 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

2.07 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. Shurjoint Piping Products.
    d. Tyco Fire & Building Products LP.
    e. Victaulic Company.
    f. 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. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AGF Manufacturing Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. 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 orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. 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.
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.

D. 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.

E. 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.

F. 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.

2.08 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. Venus Fire Protection Ltd.
6. Victaulic Company.
7. Viking Corporation.
8. 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.
3. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

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: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, 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.

2.09 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.
5. Or approved equal.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 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 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 hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

J. 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.

K. Fill sprinkler system piping with water.

L. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Escutcheons for Fire-Suppression Piping."

3.03 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. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. 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.

J. 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.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.05 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.06 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 16 Section "Identification for Electrical Systems."

3.07 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. 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.

3.08 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.010 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, 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.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. 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.
4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. 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.
4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. 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.
4. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
6. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

3.011 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, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
5. Special Applications: quick-response sprinklers where indicated at all locations.

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 13930

SECTION 15072 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Restraining braces.

1.03 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.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for site Class, Seismic use Group and Building Design Category.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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 static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

2. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Preapproval and Evaluation Documentation: an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Qualification Data: For professional Engineer.

1.06 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 and NFPA 13 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."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing

are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional Engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.
10. Or approved equal.

B. Pads: Arranged 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. Restrained Mounts: All-directional mountings with seismic restraint.

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.

2.02 NEOPRENE

A. Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO

2.03 SEISMIC-RESTRAINT DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.
10. Or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with

strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances 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.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

3. Brace a change of direction longer than 12 feet.

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

C. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. 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.

F. 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 concrete, mortar, or grout has achieved full design strength.
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.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

END OF SECTION 15072

SECTION 15078 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Brady Corporation.
b. Brimar Industries, Inc.

c. Carlton Industries, LP.
d. Champion America.
e. Craftmark.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services Inc.
j. Seton Identification Products.
k. Or approved equal.

2. Material and Thickness: Brass, 0.032-inch-thick, with predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
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.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. 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) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark.
6. emedco.
7. LEM Products Inc.
8. Marking Services Inc.
9. National Marker Company.
10. Seton Identification Products.
11. Stranco, Inc.

12. Or approved equal.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, with predrilled holes for attachment hardware.

C. Letter Color: Red.

D. Background Color: Black.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. 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.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ActionCraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Services Inc.
11. Seton Identification Products.
12. Or approved equal.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. 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 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

F. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.04 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ActionCraft Products, Inc.
2. Brady Corporation.
3. Brimar Industries, Inc.
4. Carlton Industries, LP.
5. Champion America.
6. Craftmark.
7. emedco.
8. Kolbi Pipe Marker Co.
9. LEM Products Inc.
10. Marking Services Inc.
11. Seton Identification Products.
12. Or approved equal.

B. 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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

C. 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.

2.05 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Craftmark.
6. emedco.
7. Kolbi Pipe Marker Co.
8. LEM Products Inc.
9. Marking Services Inc.
10. Seton Identification Products.
11. Or approved equal.

B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Pipe-Label Locations: 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. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a 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. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Wet-Pipe Sprinkler System: 2 inches, round.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15078

SECTION 15091 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 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 Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by 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.

2.03 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by 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: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Presealed Systems.
2. Or approved equal.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 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

3.01 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 7 Section "Joint Sealants."

E. 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 7 Section "Through-Penetration Firestop Systems."

3.02 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 7 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 7 Section "Through-Penetration Firestop Systems."

3.03 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.

3.04 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.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.

2. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

3. Interior Partitions:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 15091

SECTION 15096 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Escutcheons.
   2. Floor plates.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass 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 and rough-brass finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.02 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

3.01 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 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 Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated or rough-brass finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated or rough-brass finish.
i. 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.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 15096

SECTION 15113 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Trim and drain valves.

1.03 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.

a. Level 1: HCBZ - Indicator Posts, Gate Valve.
b. Level 1: HLOT - Valves.

1) Level 3: HLUG - Ball Valves, System Control.
2) Level 3: HLXS - Butterfly Valves.
3) Level 3: HMER - Check Valves.
4) Level 3: HMRZ - Gate Valves.

2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.

a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.

1) Gate valves.
2) Check valves.

a) Single check valves.

3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.02 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. NIBCO INC.
2. Victaulic Company.
3. Or approved equal.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 250 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

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. Fivalco Inc.
2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.
4. Or approved equal.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 250 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze with EPDM coating.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.04 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire & Building Products LP.
7. Victaulic Company.
8. Or approved equal.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 250 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.

8. Supervisory Switch: Internal or external.
9. Body Design: Lug or wafer or Grooved-end connections.

2.05 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve; a division of McWane, Inc.
5. Mueller Co.; Water Products Division.
6. NIBCO INC.
7. Reliable Automatic Sprinkler Co., Inc.
8. Shurjoint Piping Products.
9. Tyco Fire & Building Products LP.
10. Venus Fire Protection Ltd.
11. Victaulic Company.
12. Viking Corporation.
13. Watts Water Technologies, Inc.
14. Or approved equal.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 250 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.06 BRONZE OS&Y GATE VALVES

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. Milwaukee Valve Company.
2. NIBCO INC.
3. United Brass Works, Inc.
4. Or approved equal.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 250 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.07 IRON OS&Y GATE VALVES

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. American Cast Iron Pipe Company; Waterous Company subsidiary.
2. Clow Valve Company; a division of McWane, Inc.
3. Hammond Valve.
4. Kennedy Valve; a division of McWane, Inc.
5. Mueller Co.; Water Products Division.
6. NIBCO INC.
7. Victaulic Company.
8. Watts Water Technologies, Inc.
9. Or approved equal.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 250 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged Grooved or Threaded.

2.08 NRS GATE VALVES

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. American Cast Iron Pipe Company; Waterous Company subsidiary.
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc.

4. Mueller Co.; Water Products Division.
5. NIBCO INC.
6. Victaulic Company.
7. Or approved equal.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 250 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged Grooved or Threaded.

2.09 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Fire-End & Croker Corporation.
c. Fire Protection Products, Inc.
d. Flowserve.
e. Jomar International, LTD.
f. Kitz Corporation.
g. Legend Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Potter Roemer.
k. Red-White Valve Corporation.
l. Tyco Fire & Building Products LP.
m. Victaulic Company.
n. Watts Water Technologies, Inc.
o. Or approved equal.

2. Description:

a. Pressure Rating: 250 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.

f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

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. Fire Protection Products, Inc.
b. NIBCO INC.
c. United Brass Works, Inc.
d. Or approved equal.

2. Description:

a. Pressure Rating: 250 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

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. NIBCO INC.
b. United Brass Works, Inc.
c. Or approved equal.

2. Description:

a. Pressure Rating: 250 psig.
b. Body Material: Bronze with integral seat and screw-in bonnet.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc Holder and Nut: Bronze.
f. Disc Seat: Nitrile.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.01 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.

3.02 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 13 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

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. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 15 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 15113

PART 4 - PLUMBING

SECTION 15057 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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.

1.03 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

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.02 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.

2.03 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 15 HP and Larger: NEMA starting Code F or Code G.
2. 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.

2.04 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.

2.05 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. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

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 15057

SECTION 15061 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe positioning systems.
7. Equipment supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified Professional Engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing 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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 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. Pipe stands.
4. Equipment supports.

C. Welding certificates.

1.06 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

2.01 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.

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.

2.02 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.

2.03 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.
10. 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: 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.

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.

2.04 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, stainless- 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.

2.05 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. High-Type, Single-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: 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.

C. 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.

D. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.06 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.07 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.08 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

3.01 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. 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.

E. 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 07720 "Roof Accessories" for curbs.

F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

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.
    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.

3.02 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.

3.03 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.

3.04 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.

3.05 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 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 and metal trapeze pipe hangers and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. 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.
4. 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.
5. 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.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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.
21. 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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 15061

SECTION 15076 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.03 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.

1.04 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

2.01 EQUIPMENT LABELS

A. 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.

B. 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.

C. 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.

2.02 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: White.

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.

2.03 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 partially cover 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.

2.04 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.

2.05 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

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 9.

B. 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.

C. Pipe Label Color Schedule:

1. Domestic Water Piping:

    a. Background Color: Green.
    b. Letter Color: White.

2. Sanitary Waste Piping:

    a. Background Color: Green.
    b. Letter Color: White.

3. Storm Drainage Piping:

    a. Background Color: Green.
    b. Letter Color: White.

3.04 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: Green.
    b. Hot Water: Green.

3. Letter Color:

    a. Cold Water: White.
    b. Hot Water: White.

3.05 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15076

SECTION 15085 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Sanitary waste piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

1.03 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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

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.

C. Field quality-control reports.

1.04 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.

1.05 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.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15061 "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.

C. Coordinate installation and testing of heat tracing.

1.07 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

2.01 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. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
    d. Or approved equal.

G. 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 I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.
    f. Or approved equal.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. 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-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.; Super-Stik.
b. Or approved equal.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.; Thermokote V.
b. Or approved equal.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.
b. Or approved equal.

2.03 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Aeroflex USA, Inc.; Aeroseal.

b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.
e. Or approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by 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, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by 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, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.
e. Or approved equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.
c. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.

c. Vimasco Corporation; 713 and 714.
d. Or approved equal.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.06 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. 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: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 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:-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.

c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or approved equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Manufacturers: Subject to compliance with requirements, provide products by 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.

2.010 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by 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; 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.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. C & F Wire.
   b. Or approved equal.

2.011 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Engineered Brass Company.
   b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
   c. McGuire Manufacturing.
   d. Plumberex.
   e. Truebro; a brand of IPS Corporation.
   f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
   g. 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

3.01 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.03 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 4 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.

3.04 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 Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. 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 Section 07841 "Through Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07841 " Through Penetration Firestop Systems."

3.05 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. Stencil or 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. 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.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 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 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.

3.08 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.09 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, two locations of threaded strainers, two locations of welded strainers, 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.

3.010 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.

3.011 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1” inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 ½” inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.012 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.013 INDOOR, 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. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.

3.014 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. Piping, Concealed:

1. PVC, Color-Coded by System: 20 mils thick.

END OF SECTION 15085

SECTION 15092 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 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 Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.02 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Or engineer 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.

2.03 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by 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 engineer 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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Presealed Systems.
2. Or engineer approved equal

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 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

3.01 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 Section 7 "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 Section 7 "Through-Penetration Firestop Systems."

3.02 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 Section 7 "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 Section 7 "Through-Penetration Firestop Systems."

3.03 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.

3.04 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.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6: Cast-iron wall sleeves or Galvanized-steel wall sleeves.
    b. Piping NPS 6 and Larger: Cast-iron wall sleeves, Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe 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.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe 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-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe 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.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe 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.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves Stack-sleeve fittings or Sleeve-seal fittings.
b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 15092

SECTION 15097 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 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. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.02 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

3.01 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, cast brass 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 Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

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.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 15097

SECTION 15111 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Bronze gate valves.
7. Iron gate valves.
8. Lubricated plug valves.

B. Related Sections:

1. Section 15076 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 15140 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 15155 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. OS&Y: Outside screw and yoke.

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.05 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.

1.06 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. 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

2.01 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. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. 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.

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.

2.02 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Or approved equal.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

2.03 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. Crane Co.; Crane Valve Group; Crane Valves.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Red-White Valve Corporation.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    h. Or approved equal.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig.
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE or TFE.
    g. Stem: Bronze.
    h. Ball: Chrome-plated brass.
    i. Port: Full.

2.04 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Kitz Corporation.
    d. Sure Flow Equipment Inc.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    f. Or approved equal.

2. Description:

    a. Standard: MSS SP-72.
    b. CWP Rating: 200 psig.
    c. Body Design: Split body.
    d. Body Material: ASTM A 126, gray iron.
    e. Ends: Flanged.
    f. Seats: PTFE or TFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel.

i. Port: Full.

2.05 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Or approved equal.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.06 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Or approved equal.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 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.

2.07 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Or approved equal.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.08 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.

g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Or approved equal.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.09 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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. Nordstrom Valves, Inc.
b. Or approved equal.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: Regular or short.
e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, or gate valves.
2. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

B. If valves with specified CWP ratings are not available, the same types of valves with higher 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 Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass bronze trim.
3. Bronze Swing Check Valves: Class 125, disc.
4. Bronze Gate Valves: Class 125.

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 Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, NRS.

END OF SECTION 15111

SECTION 15123 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Expansion-compensator packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Pipe loops and swing connections.
4. Alignment guides and anchors.

1.03 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal: For each anchor and alignment guide 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 thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Welding certificates.

D. Product Certificates: For each type of expansion joint, from manufacturer.

E. Maintenance Data: For expansion joints to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Metraflex.
b. Or approved equal.

2. Minimum Pressure Rating: 150 psig unless otherwise indicated.
3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.

a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.

4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Weld

B. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Metraflex Company (The).
    b. Or approved equal.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.02 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Metraflex Company (The).
    b. Or approved equal.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.01 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least four pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 15123

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.03 SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. System purging and disinfecting activities report.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.01 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.

B. Potable-water piping and components shall comply with NSF 61.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkhart Products Corporation.
b. NIBCO Inc.
c. Viega.
d. Or approved equal.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.03 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys.

B. Flux: ASTM B 813, water flushable.

2.04 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.

c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.
h. Or approved equal.

2.05 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 Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.
i. Or approved equal.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.
f. Or approved equal.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.

6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Section 2 "Earthwork" for excavating, trenching, and backfilling.

3.02 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 copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level without pitch and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. 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.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the 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 sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.03 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. Soldered Joints for Copper Tubing: 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."

D. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.05 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 unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."

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.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.07 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for 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. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
2. 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.

3.08 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 15076 "Identification for Plumbing Piping and Equipment."

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. 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:

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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. 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.
c. 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.
d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.010 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. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Adjust calibrated balancing valves to flows indicated.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.011 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. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as Work progresses.

3.012 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. Under-building-slab, domestic water, building-service piping, NPS 2and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.013 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 for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves
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 15140

SECTION 15145 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Drain valves.
3. Water-hammer arresters.
4. Flexible connectors.

1.03 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03 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.

2.04 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. AMTROL, Inc.
    b. Josam Company.
    c. MIFAB, Inc.
    d. Precision Plumbing Products, Inc.
    e. Sioux Chief Manufacturing Company, Inc.
    f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    g. Tyler Pipe; Wade Div.
    h. Watts Drainage Products.
    i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
    j. 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.

2.05 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.

8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.
11. Or approved equal.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install water-hammer arresters in water piping according to PDI-WH 201.

B. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.02 CONNECTIONS

A. Comply with requirements for ground equipment in Section 16 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 16 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

END OF SECTION 15145

SECTION 15150 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.03 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.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.06 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste 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 Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 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.

2.02 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. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. ANACO-Husky.
    b. Clamp-All Corp.
    c. Dallas Specialty & Mfg. Co.
    d. MIFAB, Inc.
    e. Mission Rubber Company; a division of MCP Industries, Inc.
    f. Stant.
    g. Tyler Pipe.
    h. Or approved equal.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.05 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company; a division of MCP Industries, Inc.
4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
5) Or approved equal.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.
3) Or approved equal.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Hart Industries International, Inc.
4) Jomar International Ltd.
5) Matco-Norca, Inc.
6) McDonald, A. Y. Mfg. Co.
7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
8) Wilkins; a Zurn company.
9) Or approved equal.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Capitol Manufacturing Company.
2) Central Plastics Company.
3) Matco-Norca, Inc.
4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
5) Wilkins; a Zurn company.
6) Or approved equal.

b. Description:

1) Standard: ASSE 1079.
2) Factory-fabricated, bolted, companion-flange assembly.
3) Pressure Rating: 125 psig minimum at 180 deg F
4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Advance Products & Systems, Inc.
2) Calpico, Inc.
3) Central Plastics Company.
4) Pipeline Seal and Insulator, Inc.
5) Or approved equal.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.
6) Or approved equal.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 2 "Earthwork."

3.02 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 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 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 two 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.

K. 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.

L. 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. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 15155 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 15155 "Sanitary Waste 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. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION

A. 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.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.04 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Install 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.

6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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 and NPS 5: 60 inches with 5/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inchrod.
2. NPS 3: 48 inches with 1/2-inchrod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inchrod.

K. Install supports for vertical PVC piping every 48 inches

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. Comply with requirements for cleanouts and drains specified in Section 15155 "Sanitary Waste Piping Specialties."

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.08 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.

3.09 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.

3.010 PIPING SCHEDULE

A. 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; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

B. Aboveground, soil and waste piping NPS 5 and larger 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; heavy-duty hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

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; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Underground, soil and waste piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 15150

SECTION 15155 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Through-penetration firestop assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.04 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.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts (CO):

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Josam Company.
2) MIFAB, Inc.
3) Smith, Jay R. Mfg. Co.
4) Tyler Pipe.
5) Watts Drainage Products.
6) Zurn Plumbing Products Group.
7) 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 or raised-head, brass 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 (CODP):

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Josam Company.
2) Oatey.
3) Sioux Chief Manufacturing Co., Inc.
4) Smith, Jay R. Mfg. Co.
5) Tyler Pipe.
6) Watts Drainage Products.
7) Zurn Plumbing Products Group.
8) Or approved equal.

2. Standard: ASME A112.36.2M for threaded, 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 tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Square.
12. Top Loading Classification: Medium 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 (COWP):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products.
    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 or raised-head, 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.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains (FD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Zurn Plumbing Products Group; Specification Drainage Operation.
    d. Or approved equal.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray 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: Refer to schedule on Drawings.
13. Top of Body and Strainer Finish: Refer to schedule on Drawings.
14. Top Shape: Refer to schedule on Drawings.
15. Dimensions of Top or Strainer: Refer to schedule on Drawings.
16. Top Loading Classification: Medium Duty.
17. Funnel: Not required.
18. Inlet Fitting: Not required.
19. Trap Material: Cast iron.
20. Trap Pattern: Deep-seal P-trap.

2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by 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.

2.04 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch-minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.01 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. 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.

E. Assemble open drain fittings and install with top of hub 2 inches above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

3.02 CONNECTIONS

A. Comply with requirements in Section 15150 "Sanitary Waste and Vent Piping" for piping installation requirements. 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 Section 16 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 16 "Low-Voltage Electrical Power Conductors and Cables."

3.03 LABELING AND IDENTIFYING

A. 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 Section 15076 "Identification for Plumbing Piping and Equipment."

3.04 Field Quality Control

A. 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.

3.05 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 15155

SECTION 15159 - SANITARY SEWERAGE PUMPS

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. Submersible sewage pumps.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMPS

A. Submersible Grinder Sewage Pumps:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Barnes; Crane Pumps & Systems.
      b. Liberty Pumps.
      c. Stancor, Inc.
      d. Tsurumi America, Inc.
      e. Zoeller Company.
      f. Or approved equal.

B. Furnish and install as shown on the drawings and as specified herein, one complete Weil Pump Company Series 2400 Duplex pumping system as supplied by Cullen Company (732-988-9600), or approved equal consisting of but not limited to; two submersible grinder pump/motor assemblies, automatic liquid level control, basin cover, and all necessary appurtenances required for a properly operating pumping system to replace components and reuse the existing cast iron wet well.

C. Each pump shall have a capacity of 50 GPM at 22 Ft. TDH as measured from the bottom of the sump to the highest point in the discharge line (including pipe friction loses) while operating at 1750 RPM. Each pump shall be Weil Pump Company Model No. 2437 "C" Style Grinder Pump with 2" NPT discharge.

D. Each pump shall be constructed of close-grained high density cast iron and shall have a 3" suction and 2" discharge. The pump shall include a grinder assembly located on the suction side of the pump impeller. The cutter shall be capable of grinding all materials normally found in domestic sewage. The cutter and shredding ring assembly macerates solids into slurry and discharge to the pump impeller. The cutter and shredding ring shall be made from 440C super hard corrosion resistant stainless steel. This assembly shall leave no exposed shaft to permit packing of solids. The shredding ring shall be field reversible to provide new cutting edges to double the life.

E. The impeller shall be multi vane, semi-open type and shall be made of cast bronze and accurately machined to the proper diameter. All impellers are to be statically and dynamically balanced.

F. Pump motors shall have a maximum size of 1 HP and shall operate at a maximum speed of 1750 RPM, and be suitable for operation with 208 volts, 3 phase, and 60 Hz current. Motors shall be housed in a watertight cast iron shell and shall be of the air-filled design for maximum efficiency. Windings shall have class F insulation. Oil filled motors will not be considered

equal. Motor end bell shall be designed as a terminal box and separated from the motor shell by a combination bearing support and inspection plate that shall permit viewing and access to the motor from the top side of the unit. Pumps shall be furnished with an upper and lower permanently lubricated double seal ball bearing having an L-10 rating. Motors using sleeve type bearings in either position will not be acceptable. The mating surfaces between the motor end bell, motor shell, and pump case shall be sealed by means of Buna-N O-rings. Motor shaft shall be 300 series stainless steel with key way for positive positioning of the impeller.

G. Each pump and motor assembly exterior and pump volute interior shall be finish coated with a premium black epoxy (3-4 mil) for superior environmental and chemical corrosion resistance.

H. The liquid level controller shall be designed for controlling a Duplex pumping system and shall be of the “low head room” pedestal float switch design for a replacement “in-kind” of existing level sensing switches. The pedestal float switch shall be a Weil Model 8212 mechanical alternating level control for low head room applications. It shall consist of a mechanical alternator with two (2) two-pole switches, stainless steel float rod, guide pipe for float rod, stainless steel cylindrical float, adjustable brass stops and a pedestal assembly with bottom plate designed to mount over the level control opening in the Weil Model 8805 wet well cover. The level control switch shall include the optional HWA contact. All level sensing shall be accomplished with the single pedestal float switch.

I. There shall be furnished for remote mounting, a duplex, non-alternating, pump control panel Weil Model 8155 arranged for wall mounting and furnished in a NEMA 1 steel enclosure containing:

- U/L Listed Label
- One lockable panel disconnect
- Two lockable pump disconnects, one for each pump motor
- Two contactors-industrial duty
- Two motor overload circuit protectors
- Control circuit transformer
- Two T-O-A pump selector switches
- Two pump run lights
- High water alarm system with test button, silence capability and dry contacts
- High water alarm audible
- Control terminal board, numbered and wired

J. The pumps shall be installed in the existing, cast iron 36" inside diameter wet well. The existing basin cover shall be replaced with a Weil Model 8805, round, duplex steel basin cover containing two pump access openings, level control opening, and 2" vent flange. Two pump access opening cover plates shall be supplied with 2" discharge pipe opening and electric cord grommet for pump power cord. The Weil 8805 cover and 8817 pump access opening cover

plates shall be finish coated with a premium black epoxy (3-4 mil) for superior environmental and chemical corrosion resistance.

K. Plumbing contractor will be required to provide a union, check and gate valves on the discharge of each pump, complete the piping as shown.

L. Plumbing contractor shall allow for a minimum of 4-5 weeks lead time when ordering pumps and accessories.

M. The final installation shall be reviewed by a factory authorized representative during the included startup service and the basin shall be free from debris prior to starting the pumps into operation.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15057 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 15150 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

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. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
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. Pumps and controls will be considered defective if they do not pass tests and inspections.

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 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 15159

SECTION 15415 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes pressure water coolers and related components.

1.03 SUBMITTALS

A. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Maintenance Data: For pressure water coolers to include in maintenance manuals.

1.04 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. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 6 of each.

PART 2 - PRODUCTS

2.01 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Wall mounted, with bottle filler, wheelchair accessible.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Halsey Taylor.
    b. Haws Corporation.
    c. Or approved equal.

2. Cabinet: Single level with bottle filling station, vinyl-covered steel with stainless-steel top.
3. Bubbler: One, with adjustable stream regulator.
4. Control: Push bar.
5. Bottle filling station.
6. Drain: Grid with NPS 1-1/4 tailpiece.
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    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.

10. Capacities and Characteristics:

    a. Cooled Water: Basis of design as scheduled on Drawing.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Electrical Characteristics:
        1) Volts: 120-V ac.
        2) Phase: Single.
        3) Hertz: 60.

11. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install fixtures level and plumb according to roughing-in Drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-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 Section 15111 "General-Duty Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 15097 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07900 "Joint Sealants."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 15140 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 15111 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 15150 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.05 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15415

SECTION 15416 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.03 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

C. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.01 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      a. Kohler.
      b. Crane Plumbing, L.L.C.
      c. Or approved equal.

   1. Bowl:

      a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
      b. Material: Vitreous china.
      c. Type: Siphon jet.
      d. Style: Flushometer valve.
      e. Height: Handicapped, complying with ICC/ANSI A117.1.
      f. Rim Contour: Elongated.
      g. Water Consumption: 1.1 gal. to 1.6 gal. per flush.
      h. Spud Size and Location: NPS 1-1/2; top.
      i. Color: Selected by Architect

   2. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.
   3. Flushometer Valve: Battery Powered, solenoid-actuatordiaphragm flushometer.
   4. Toilet Seat: See Toilet Seat section.

2.02 FLUSHOMETER VALVES

A. Battery-Powered, Solenoid-Actuator, Diaphragm Flushometer Valves:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      a. Coyne & Delany Co.
      b. Kohler Co.
      c. TOTO USA, INC.
      d. Zurn Industries, LLC; Commercial Brass and Fixtures.
      e. Or approved equal.

2.03 TOILET SEATS

A. Toilet Seats:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Church Seats.
    b. Or approved equal.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in Drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Support Installation:
1. Install floor mounted, back outlet water closets attached to building floor substitute, onto waste fitting seals: and attach to support.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 15097 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 07900 "Joint Sealants."

3.03 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 15140 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 15150 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.04 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in flushometers.

3.05 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 15416

SECTION 15421 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

1.03 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

C. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1.04 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. 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.

PART 2 - PRODUCTS

2.01 VITREOUS CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      a. Kohler.
      b. Crane Plumbing, L.L.C.
      c. Or approved equal.

   2. Fixture:

      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: For wall hanging. Rectangular 21 x 18 inches, bowl size 16 x 10 inches.
      c. Nominal Size:
      d. Faucet-Hole Punching: Single hole.
      e. Faucet-Hole Location: Top.
      f. Color: Selected by Architect.
      g. Mounting Material: Chair carrier.

   3. Faucet: Solid-Brass, Automatically Operated Battery Powered Faucets.
   4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier with escutcheons. Include rectangular, steel uprights.

2.02 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, battery-powered, electronic-sensor-operated, mixing, solid-brass valve.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      a. Coyne & Delany Co.
      b. Kohler Co.
      c. TOTO USA, INC.
      d. Zurn Industries, LLC; Commercial Brass and Fixtures.
      e. Or approved equal.

   2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
   3. 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.

4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid brass.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck.
10. Spout: Rigid type.
11. Spout Outlet: Laminar flow Spray.
12. Drain: Not part of faucet.

2.03 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 3/8 (DN 10).
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces.

2.04 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: Basis of Design, refer to Schedule on Drawings. Or approved equal.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick; and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install lavatories level and plumb according to roughing-in Drawings.

B. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 15097 "Escutcheons for Plumbing Piping."

C. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07900 "Joint Sealants."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 15140 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 15150 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.05 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 15421

SECTION 15422 – COMMERCIAL SINKS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Utility sinks.
2. Sink faucets.
3. Supply fittings.
4. Waste fittings.

1.03 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

C. Maintenance Data: For sinks to include in maintenance manuals.

1.04 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. 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.

PART 2 - PRODUCTS

2.01 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Refer to Architectural Sections.

2. Faucet(s): See "Sink Faucets" Article.

a. Number Required: One.
b. Mounting: On ledge.

3. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.
b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Loose key.
2) Risers: NPS 1/2, chrome-plated, soft-copper flexible tube.

4. Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.
b. Trap(s):

1) Size: Basis of design, refer schedule on Drawings.
2) Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

5. Mounting: On counter with sealant.

2.02 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Refer to Architectural Sections.

2.03 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2
2. Chrome-plated, soft-copper flexible tube.

2.04 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: Refer to specified product.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.05 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

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install sinks level and plumb according to roughing-in Drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 15111 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 15097 "Escutcheons for Plumbing Piping."

F. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07900 "Joint Sealants."

G. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 15085 "Plumbing Piping Insulation."

3.03 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 15140 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 15150 "Sanitary Waste and Vent Piping."

3.04 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.05 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 15422

SECTION 15441 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. In-line, sealless centrifugal pumps.

1.03 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.05 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.07 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Grundfos Pumps Corp.
3. TACO Incorporated.
4. Or approved equal.

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze, with threaded or companion-flange connections.
3. Impeller: Plastic.
4. Motor: Single speed, unless otherwise indicated.

D. Capacities and Characteristics:

1. Capacity: as indicated on the Drawings.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 16 Sections.

2.03 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 50 to 125 deg F.
3. Enclosure: NEMA 250, Type 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V, ac.
7. Settings: Start pump at 105 deg F and stop pump at 120 deg F.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.

1. Comply with requirements for hangers and supports specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Install thermostats in hot-water return piping.

3.03 CONNECTIONS

A. Comply with requirements for piping specified in Division 15 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Horizontally mounted, in-line, separately coupled centrifugal pumps.

2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 15 Section "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Division 15 Section "Domestic Water Piping Specialties."
3. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps

D. Comply with Division 16 Sections for electrical connections, and wiring methods.

E. Connect thermostats, to pumps that they control.

3.04 IDENTIFICATION

A. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 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.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats, for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.
b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.06 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 15441

SECTION 15487 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Commercial, electric, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.02 PERFORMANCE REQUIREMENTS

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

B. Shop Drawings:

   1. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

B. Source quality-control reports.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.06 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/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.

a. Commercial, Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Two years.

b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.01 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Bradford White Corporation.
   b. Lochinvar Corporation.
   c. Or approved equal.

2. Standard: UL 1453.
3. Storage-Tank Construction: ASME-code, steel vertical arrangement.

a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.

1) NPS 2and Smaller: Threaded ends according to ASME B1.20.1.

b. Pressure Rating: 160 psig
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    c. Insulation: Comply with ASHRAE/IESNA 90.1.
    d. Jacket: Steel with enameled finish.
    e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
    f. Temperature Control: Adjustable thermostat.
    g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
    h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

B. Capacity and Characteristics:

1. Capacity: See schedule on Drawings.
2. Recovery: See schedule on Drawings.
3. Power Demand: See schedule on Drawings.
4. Heating Elements:

    a. Number of Elements: Three.

5. Kilowatts Each Element: See schedule on Drawings.

6. Electrical Characteristics:

    a. As scheduled on the Drawings.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    a. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    b. State Industries.
    c. Or approved equal.

2. 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.
3. 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.

4. Capacity and Characteristics:

a. See schedule on Drawings.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

C. Heat-Trap Fittings: ASHRAE 90.2.

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

E. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Install on galvanized steel support stand in CTE.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.

3. 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.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-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.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 15111.

C. 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.

D. 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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 15145 "Domestic Water Piping Specialties."

E. Install thermometers on outlet piping of electric, domestic-water heaters.

F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

G. Fill electric, domestic-water heaters with water.

H. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 15140 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.04 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.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

PART 5 - HVAC

SECTION 15058 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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.

1.03 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

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.02 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.

2.03 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 15 HP and Larger: NEMA starting Code F or Code G.
2. 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.

2.04 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.

2.05 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. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

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 15058

SECTION 15059 - VARIABLE FREQUENCY DRIVES FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DESCRIPTION

A. This Specification is to cover a complete Variable Frequency Drive (VFD aka: VSD, AFD, ASD, Inverter, AC Drive, et al) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a "brand labeled" drive. All VFDs installed on this project shall be from the same manufacturer.

1.03 QUALITY ASSURANCE

A. Referenced Standards and Guidelines:

1. Institute of Electrical and Electronic Engineers (IEEE)
    a. IEEE 519-1992, Guide for Harmonic Content and Control.
2. Underwriters Laboratories (as appropriate)
    a. UL508
    b. UL508A
    c. UL508C
3. National Electrical Manufacturer's Association (NEMA)
    a. ICS 7.0, AC Adjustable Speed Drives
4. International Electrotechnical Commission (IEC)
    a. EN/IEC 61800-3
5. National Electric Code (NEC)
    a. NEC 430.120, Adjustable-Speed Drive Systems
6. International Building Code (IBC)
    a. IBC Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications:

1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL labeled 100 kA RMS Symmetrical, 600V max. C
2. CE Mark – The base VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2). Base drives that only meet the Second Environment (Category C3, C4) shall be supplied with filters to bring the drive in compliance with the First Environment levels.

3. The entire VFD assembly, including the bypass (if specified), shall be seismically certified and labeled as such in accordance with the International Building Code (IBC):
    a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
    b. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake test data as defined by ICC AC-156.
    c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.
    d. Special seismic certification of equipment and components shall be provided by OSHPD preapproval.
4. Factory authorized start up and Owner training should be provided locally upon request.

1.04 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions, conduit entry locations and weight.
2. Customer connection and power wiring diagrams.
3. Complete technical product description include a complete list of options provided. Any portions of this Specification not met must be clearly indicated or the supplier and Contractor shall be liable to provide all additional components required to meet this Specification.

1.05 BUILDING INFORMATION MODELING (BIM)

A. BIM objects shall contain IFC parameters and associated data applicable to building system requirements. These elements shall support the analytic process including size, clearance, location, mounting heights, and system information where applicable.

B. VFD BIM models shall contain as a minimum the following attributes:

1. Input voltage
2. Current rating
3. Model number
4. Manufacturer
5. Enclosure type

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Low Voltage HVAC Drives model ACH550.
2. Or approved equal.

2.02 VARIABLE FREQUENCY DRIVES

A. The VFD package as specified herein and defined on the VFD schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility.

B. The VFD shall provide full rated output from a line of ±10% of nominal voltage. The VFD shall continue to operate without faulting from a line of +30% to -35% of nominal voltage.

1. VFDs shall be capable of continuous full load operation under the following environmental operating conditions:
   a. -15 to 40° C (5 to 104° F) ambient temperature. Operation to 50° C shall be allowed with a 10% reduction from VFD full load current.
   b. Altitude 0 to 3300 feet above sea level. Operation to 6600 shall be allowed with a 10% reduction from VFD full load current.
   c. Humidity less than 95%, non-condensing.

C. All VFDs shall have the following standard features:

1. All circuit boards shall be coated to protect against corrosion.
2. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.
4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VFD programming shall be held in non-volatile memory and is not dependent on battery power
5. The VFD’s shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required, based on the temperature of and run command to the drive. VFD protection shall be based on thermal sensing and not cooling fan operation.
7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

10. Product harmonic compliance shall be restricted to that identified by IEC/EN 61000-3-12.
11. VFDs through 200 HP shall have internal swinging (non-linear) chokes providing impedance equivalent to 5% to reduce the harmonics to the power line. Swinging choke shall be required resulting in superior partial load harmonic reduction. Linear chokes are not acceptable. 5% impedance may be from dual (positive and negative DC bus) chokes, or 5% swinging AC line chokes. VFD's with only one DC choke shall add an AC line choke.
12. The input current rating of the VFD shall not be greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.122. Input and output current ratings must be shown on the VFD nameplate.
13. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV's shall have a minimum 125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include an external TVSS (Transient Voltage Surge Suppressor).
14. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
15. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two-zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
16. If the input reference is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
17. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

D. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e.

valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

4. Two (2) programmable analog inputs shall accept current or voltage signals.
5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.
7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable. Drives that have only two (2) relay outputs must provide an option card that provides additional relay outputs.
8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety input status shall also be transmitted over the serial communications bus.
9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
10. Seven (7) programmable preset speeds.
11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
14. The VFD shall include password protection against parameter changes.

E. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
   1. Start-up assistant
   2. Parameter assistants

a. PID assistant
b. Reference assistant
c. I/O assistant
d. Serial communications assistant
e. Option module assistant
f. Panel display assistant
g. Low noise set-up assistant

3. Maintenance assistant
4. Troubleshooting assistant
5. Drive optimizer assistants

F. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
2. Motor Speed (RPM, %, or Engineering units)
3. Motor Current
4. Motor Torque
5. Motor Power (kW)
6. DC Bus Voltage
7. Output Voltage

G. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

H. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
a. Data Sharing – Read Property – B.
b. Data Sharing – Write Property – B.
c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
e. Device Management – Communication Control – B.

3. Serial communication capabilities shall include, but not be limited to; run-stop controls, speed set adjustment, and lock and unlock the keypad. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
4. Serial communication in bypass (if bypass is specified) shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
5. The VFD / bypass shall allow the BAS to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.
6. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

I. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2) with up to 100 feet of motor cable. Second environment (Category C3, C4) is not acceptable, no Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment (C2).

J. DRIVE OPTIONS – Options shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. Circuit Breaker - Door interlocked padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options. Circuit breaker option shall be available with or without systems requiring bypass.
2. Disconnect Switch with Fuses - Door interlocked, padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Drive input fusing is included.
3. Fieldbus adapters – The following optional fieldbus adapters shall be available as plug-in modules.

a. LonWorks
b. DeviceNet
c. Ethernet IP
    1) ControlNet over Ethernet & ModBus TCP
d. BACnet IP
e. Profibus

K. BYPASS OPTION – Bypasses shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.
2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.
3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.
4. The drive and bypass package shall be seismic certified and labeled to the IBC:
    a. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake table test data as defined by ICC AC-156.
    b. Special seismic certification of equipment and components shall be provided by OSHPD preapproval.
5. Drive Isolation Fuses - To ensure maximum availability of bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor "isolation contactors" are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.
6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
7. Motor protection from single phase power conditions - the bypass system must be able to detect a single-phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single-phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.
9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.
    a. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the

keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (Amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad "Hand" or "Auto" selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.

b. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.

10. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.
11. The digital inputs for the system shall accept 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.
12. There shall be a coordinated run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.
13. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.
14. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
15. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

a. Over current
b. Over voltage
c. Under voltage
d. Loss of analog input

16. The following operators shall be provided:
    a. Bypass Hand-Off-Auto
    b. Drive mode selector
    c. Bypass mode selector
    d. Bypass fault reset
17. The bypass shall include the ability to select the operating mode of the system (VFD/Bypass) from either the bypass keypad or digital input.
18. The bypass shall include a two-line, 20-character LCD display. The display shall allow the user to access and view:
    a. Energy savings – in US dollars
    b. Bypass motor amps
    c. Bypass input voltage– average and individual phase voltage
    d. Bypass power (kW)
    e. Bypass faults and fault logs
    f. Bypass warnings
    g. Bypass operating time (resettable)
    h. Bypass energy (kilowatt hours – resettable)
    i. I/O status
    j. Parameter settings / programming
    k. Printed circuit board temperature
19. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.
    a. Power-on (Ready)
    b. Run enable
    c. Drive mode selected
    d. Bypass mode selected
    e. Drive running
    f. Bypass running
    g. Drive fault
    h. Bypass fault
    i. Bypass H-O-A mode
    j. Automatic transfer to bypass selected
    k. Safety open
    l. Damper opening
    m. Damper end-switch made
20. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.
21. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.
    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault

e. Bypass fault
f. Bypass H-O-A position
g. Motor proof-of-flow (broken belt)
h. Overload
i. Bypass selected
j. Bypass run
k. System started (damper opening)
l. Bypass alarm
m. Over temperature

22. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
23. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps.
24. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezeStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.
25. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.
26. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.
27. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.
28. Drive Service Switch – Drive service switches shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. VFD/Bypass configurations that utilize contactors as a means to remove VFD input power for the purpose of VFD servicing are not acceptable. NEC Code does not recognize a contactor as a means of disconnect in a motor control circuit.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be the responsibility of the Mechanical Subcontractor. The Subcontractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

B. Power wiring shall be completed by the Electrical Subcontractor, to NEC code 430.122 wiring requirements based on the VFD input current. The Subcontractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.02 START-UP

A. Factory start-up shall be provided for each drive by a factory authorized service center. A start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

3.03 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line connected to factory support personnel located in the US shall be available. Technical support offered only through the local sales office is not acceptable.

B. Training shall include installation, programming and operation of the VFD, bypass and serial communication. Factory authorized start up and Owner training to be provided locally upon request.

3.04 WARRANTY

A. PROPOSED: The VFD Product Warranty shall be 36 months from the date of factory shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 15059

SECTION 15062 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.04 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.

1.05 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. Pipe stands.
4. Equipment supports.

C. Welding certificates.

1.06 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

2.01 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.

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.

2.02 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.

2.03 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.
10. Or approved equal.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psigor ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 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.

2.05 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. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
3. 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.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.06 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.07 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

3.01 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 Division 7 Section "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 2-1/2and 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.
    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. 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.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

4. Pipes NPS 8and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 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.

3.03 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.

3.04 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.

3.05 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 Division 9 painting Sections. Section "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 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 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. 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.
4. 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.
5. 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.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. 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.
15. 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.
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 24if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

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 24if 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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 15062

SECTION 15071 - VIBRATION ISOLATION, SEISMIC, WIND LOAD RESTRAINTS FOR HVAC COMPONENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections apply to this Section

B. This section specifies required vibration control and seismic restraints for all equipment, where applicable, with the wind load requirements for all equipment in outdoor locations. When projects are located in a geographically active seismic, wind or flood location, Section 1.4, General Design and Performance Requirements, will elaborate on those requirements and include specifics pertaining to a facility's "continued operation." Para. 1.2, Section D is a partial list of components covered herein.

1.02 SUMMARY

A. This section includes the following:

1. All equipment, piping and ductwork as noted on the Drawing's schedule or in the Specification shall be seismically braced if the building is so classified as listed herein. Vibration control shall apply as described in all cases herein.
2. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2021. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.
3. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
4. Seismic bracing, wind load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
5. It is the intent of the seismic and wind load portion of this Specification to keep all mechanical, building system components in place during a seismic or high wind event and additionally operational where the occupancy category of the building so requires as listed herein.
6. All such systems must be installed in strict accordance with seismic/wind codes, component manufacturer's and building construction standards.
7. This Specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.
8. Any variation, which results in non-compliance with the Specification Requirements, shall be corrected by the Contractor in an approved manner.

B. The Work in this section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork and equipment, all referred to as components.
2. Component isolation bases.

3. Seismic restraints for isolated components.
4. Seismic restraints for non-isolated components.
5. Wind restraints for isolated components.
6. Wind restraints for non-isolated components.
7. Certification of seismic, wind or flood restraint designs.
8. Installation supervision.
9. Design of attachment of housekeeping pads.
10. All components requiring IBC compliance and certification.
11. All inspection and test procedures for components requiring IBC compliance.

C. All mechanical equipment, pipe and ductwork, within, on or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.

D. Components referred to below are typical. (Components not listed are still included in this Specification.) All systems that are part of the building in any way are referred to as components, including:

- AC Units
- Energy Recovery
- Cabinet Unit Heaters
- Condensing Units
- Curbs
- Ductwork
- Equipment Supports
- Fans (all types)
- Fan Coil Units
- Pipe
- Pumps (all types)
- Risers
- Rooftop Units
- Supports
- Unit Heaters
- VAV Boxes
- Vibration Isolators
- Water Heaters

1.03 DEFINITIONS (building and components, all codes)

A. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2021)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

B. LIFE SAFETY AND HIGH HAZARD

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels. (Life Safety)
2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers. (Life Safety)
3. All medical and life support systems. (Life Safety)
4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature. (Life Safety)

5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department. (Life Safety)
6. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells. (High Hazard)
7. Heating systems in any facility in Seismic Use Group III, IBC-2021 or Occupancy Category IV, IBC-2021 where the ambient temperature can fall below 32 degrees Fahrenheit. (Life Safety)

C. GENERAL

Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.

Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services, when such agency has been approved.

Attachment: See Positive Attachment below.

Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2021), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-05 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609.3 ASCE 7-05 for basic wind speed determination in non-hurricane prone regions.

Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also Longitudinal Bracing and Transverse Bracing. Together, they resist environmental loads from any direction.

Certificate of Compliance: A certificate stating that materials and products meet specified standards or that Work was done in compliance with approved construction documents, provided by an approved agency. (Certificate to be supplied by equipment component manufacturer.)

Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.

Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5.

Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.

Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.

Consequential Damage: The functional and physical interrelationship of components, their

supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.

Equipment: Systems associated with ducts, pipes and conduits also called components.

Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel, gas, fuel oil, medical gas, or compressed air.

Hazardous Contents: A material that is highly toxic or potentially explosive or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.

Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.

Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency *(see Section 1703.5 and "Label" and "Manufacturer's Designation" and "Mark")*.

Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency *(see Section 1703.5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark")*.

Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.

Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.

Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.

Mark: An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material *(see also "Inspection Certificate," "Label" and "Manufacturer's Designation").*

Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules *(see also "Inspection Certificate," "Label" and "Mark".)*

Occupancy Category: A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.

Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy cast in anchors and drill in wedge shaped anchor bolts to concrete and welded or bolted connections directly to the building structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.

Seismic: Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.

Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group or Occupancy Category and the severity of the design earthquake ground motion at the site.

Seismic Forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.

Seismic Use Group, Occupancy Category, IBC-2021: A classification assigned to a building based on its use as defined in *Section 1604.516.2.*

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2 (IBC-2021).

Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special documents and referenced standards *(see Section 1704, IBC*-2021*)*.

Special Inspection, Continuous: The full-time observation of Work requiring special inspection by an approved special inspector who is present in the area where the Work is being performed.

Special Inspection, Periodic: The part-time or intermittent observation of Work requiring special inspection by an approved special inspector who is present in the area where the Work has been or is being performed and at the completion of the Work.

Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.

Transverse bracing: Bracing that prevents a component from moving from side to side.

Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

1.04 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. General Design Requirements.

1. SEISMIC CONSIDERATIONS: This project has seismic design requirements as follows:

    a. Occupancy Category I, II & III (Seismic Design Category C through F)
        Life Safety Components (Ip = 1.5)
        High Hazard Components (All Gas Fired Components; Indoor and Outdoor) (Ip = 1.5)
        Components affected by Consequential Damage (Ip = 1.0)

2. WIND CONSIDERATIONS: This project has wind design requirements as follows:

    a. Wind load in hurricane, tornado and or wind-borne debris regions (90 plus mph) having a building height less than 60 feet. (Rooftop structures; Section 6.5.15.1 of ASCE 7-05 design requirements apply)

B. General Design Performance Requirements

1. Seismic and Wind Load Certification and Analysis:

    a. Attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the mounting system, seismic or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the Shop Drawings. Seismic loads shall have their calculations based on seismic loads as established in Specification *Section 1.4, Paragraph B, article 7, Design Seismic Loads*. Wind loads shall have their calculations based on *Section 1.4, Paragraph B, article 8, Design Wind Loads*. A registered Professional Engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analysis, or as required by local building codes.
    b. Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping or ductwork in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:

        1. International Building Code, IBC and ASCE applicable state and local codes.

2. Importance Factor, Ip = 1.5 Components:

    a. In addition to all of the above provisions, for components having an Ip greater than 1.0, all trades shall comply with Sections 16 and 17 of the International Building Code using, when available, vendors that comply with the provisions stated herein and submitting the special inspections listed within these Specifications. Where compliance is not possible, each Contractor shall submit a vendor report (form CVC-1 at end of this Specification) clearly indicating that none of the specified, listed or other vendors known to the Contractor meets the compliance, testing and certification portions of the IBC Specification's Sections 16 and 17. Special inspections of the component installation shall still be conducted (Section 1.4, Paragraph B, Article 4) even if no vendors meet the following requirements. All non-isolated and isolated equipment (components) shall be secured to the structure in

accordance with that code.

3. All component manufacturers shall submit for approval the following as required below:

    a. For all life safety system components noted in this Specification: the Approved Agency's Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include anchorage, structural and on-line capability. Use of seismic experience data shall be permitted if evidence confirms that the historical based component has the same construction and weight and accompanying center of gravity as submitted unit and basis of experience claim conforms to loads derived in testing with accompanying accelerations based on AC-156. Seismic qualification by seismic experience data based upon nationally recognized procedures acceptable to the authority having jurisdiction shall be deemed to satisfy the design and evaluation requirements provided that the substantiated seismic capacities equal or exceed the seismic demands determined in accordance with Sections 13.3.1 and 13.3.2 of ASCE 7-05.
    b. In addition, all components needed for the continued operation of the facility in the above stated categories will have the manufacturer of that component submit the Approved Agency's Certificate of Compliance for their equipment when the Seismic Design Category is C through F. Analytical or Shaker Test certification through the component's load path to structure at its center of gravity shall include on line capability. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Use Group. Where components do not effect the facility's functional operation but could affect the performance of other components should they dislodge, only anchorage of that component requires compliance. Components needed for continued operation of the building require Analytical or Shaker Test certification through the total component's load path to structure calculated at its center of gravity. Certification shall prove anchorage, structural and on line capability. For use of seismic experience data, see (a) above.
    c. All components containing hazardous or flammable materials will have the manufacturer of the component submit the Approved Agency's Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of C through F. Testing shall be conducted by Analytical or Shaker Test through the total component's load path to structure at its center of gravity and shall prove anchorage, structural capability and hazardous material containment. Testing shall prove that no internal component will rupture to insure against loss of hazardous or flammable (explosive) material that could support combustion, ignite or contaminate.

    d. All components requiring anchorage compliance only, not listed in the above categories, shall have the manufacturer of each component submit a PE stamped calculation package stating that their project specific equipment will accept anchorage by calculating its reactions through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of C through F.

4. Special and Periodic Inspection: (Occupancy Category IV Projects)

The following systems shall require Special Inspection and Periodic Special Inspection for seismic installation and anchorage during the course of construction, as defined earlier in this section for all buildings in Seismic Design Categories C through F.

a. All smoke control systems. Periodic Special Inspection during erection of ductwork and prior to concealment, for leakage testing. Additionally, prior to occupancy for pressure differential testing. (see IBC-2021, Section 1704.14)
b. All electrical components for standby or emergency power systems require Periodic Special Inspection. *
c. All electrical equipment in Seismic Design Categories E and F. (Periodic)*
d. All flammable, combustible and highly toxic piping and their associated mechanical systems. (Periodic)*
e. All ductwork containing hazardous materials. (Periodic)*
f. All equipment using combustible or toxic energy sources. (Special $^{-1}$)
g. All electric motors, transformers, switchgear unit substations and motor control centers. (Special $^{-1}$)
h. Reciprocating and rotating type machinery. (Special $^{-1}$)
i. Pipe, 3" and larger. (Special $^{-1}$)
j. Tanks, heat exchangers and pressure vessels. (Special $^{-1}$)
k. Isolator units for seismic isolation system. (Periodic)*
l. Manufacturer's written Quality Control Program for projects in Seismic Design Categories E or F.

5. Contractor Responsibilities and Approvals: (Occupancy Category IV Projects)

    a. Each Contractor responsible for the installation of the components asterisked above (*) shall be responsible for submitting a written Contractor's Statement of Responsibility (IBC Section 1706.1) (as outlined below) to the design team for their approval.
    b. In addition all -1 items above require Special Inspection in accordance with IBC Section 1707.8 (Form CQAP and SQA-1) at the end of this Specification.
    c. Contractor Shall:

        1. Identify the components that are part of the Quality Assurance Plan. (Asterisked above)*
        2. Identify all Special Inspection and Testing for components installed as part of this Contract.
        3. List control procedures within the Contractor's organization for all special inspection and testing, including methods, frequency of reporting and their distribution of those reports.
        4. List all personnel, including their qualifications, exercising control over the seismic aspects of the project.

6. Seismic Use Group I & II, IBC-2021 & Occupancy Category II & III Structures, IBC-2021, Ip 1.0, Seismic Design Category C:

    a. Projects in these categories require seismic bracing for all life safety and high hazard

components, Paragraph 1.3B sub-paragraphs 1, 2, 5 and 6. In addition, any un-braced component that could adversely affect the performance of a component that must remain functional, Ip 1.5, or could cause the failure or release of hazardous materials (gas or liquid fuel), must be braced or anchored to avoid such failure. This includes any component that could fall or move laterally. (Consequential Damage, ASCE 7-05, Section 16.2.3.)

7. Design Seismic Loads:

   a. Projects in the United States have a minimum design load of 0.4g for statically mounted components and 0.5g for resiliently mounted components. Actual loads for both internal and external isolation and/or anchorage of components shall be as above or as calculated for the specific project location but in no event shall it be less than the above.
   b. Exclusions for seismic restraint of piping and duct shall be according to applicable codes and as stated herein. The minimum horizontal restraint capability shall be 0.4g horizontal and 0.27g vertical (in addition to the gravity load). Life safety equipment defined above shall be designed to withstand a horizontal load of 0.9g and a vertical load of 0.6g.
   c. Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment depth and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity.
   d. Vertical load shall be calculated at 1/3 the horizontal load as a minimum, or, as prescribed by the code as 0.2 times Sds.
   e. Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of this section, all articles.
   f. A Seismic Design Errors and Omissions Insurance Certificate MUST accompany the seismic restraint equipment manufacturer's calculation. Product liability insurance certificates are not acceptable.
   g. Whether the equipment is internally or externally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic or wind attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is acceptable provided that the following five conditions are met and verified.

      1. Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.
      2. Shear and tension allowables are obtained from an accredited third party source, such as ICC or NDS, not from the screw manufacturer.
      3. Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.
      4. Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.

5. The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.

h. Failure is defined as the discontinuance of any attachment point or load path between component and structure. Permanent deformation of the component is acceptable as long as the component continues to operate without failure and, if permanent, it is within acceptable manufacturing or structural tolerances.

8. Design Wind Loads:

a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.

1. If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base Type B-3 if isolated, Base type B-4 if non-isolated.
2. If component is support mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base Type B-5 if isolated, Base type B-6 if non-isolated.

3. If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.

b. Loads and calculations shall be based on IBC-2021, figure 1609 and related sections in ASCE 7-05.
c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), *the force on* roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-05.
d. Equivalent basic wind speed shall be based on IBC-2021, Table 1609.3.1.
e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

1.05 SUBMITTALS

A. Refer to Part 1, General.

B. Product Data: The manufacturer of vibration isolation, seismic and wind restraints shall provide submittals for products as follows:

1. Descriptive Data:

a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the Specification.
b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and restraints by referencing numbered descriptive Drawings.

2. Shop Drawings:

a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
b. Provide all details of suspension and support for ceiling hung equipment.
c. Where walls, floors, slabs or Supplementary Steel Work are used for restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturer's submittals must include spacing and maximum seismic/wind loads at the restraint points.
d. Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third party certification.
e. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer of vibration isolation, seismic and wind load control equipment or manufacturer's approved representative shall have the following responsibilities:

1. Determine vibration isolation and restraint sizes and locations.
2. Provide vibration isolation and restraints as scheduled or specified.
3. Provide calculations and materials, if required, for restraint of non-isolated equipment.
4. Provide installation instructions in writing, Drawings and trained field supervision, where necessary, to insure proper installation and performance.
5. Certify correctness of installation upon completion, in writing.
6. All provisions of Section 1.4, General Design and Performance Requirements.

B. All manufacturers of vibration control, seismic, wind or flood restraining systems must provide a Seismic Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the seismic restraint provider.

C. All manufacturers of any type of equipment including OEM are responsible for Section 1.4.

D. Equipment manufacturer's substitution of internally or externally isolated and/or restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their engineering department, PE stamped and certified per the section on the Seismic Restraint Design (See Section 1.4B, article 3), stating that the seismic restraints are in full compliance with these Specifications. Where used on an Essential or High Hazard Facility, manufacturer's certification proving on line capability shall be required in addition to all requirements stated in Section 1.4B. Letters from field offices or representatives are unacceptable.

E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:

    1. Indoor or outdoor mounted equipment over or adjacent to:

        a. Office locations
        b. Classroom locations

1.7 RELATED WORK

A. Housekeeping pad structural design, including its attachment to building structure, shall be by the Structural Engineer of record or as shown on the Contract Drawings. Attachment of all components and restraints to the pad and size of the pad shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the Concrete Section Subcontractor, or by the Contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad.

B. The project's Structural Engineer shall design all roof and interior steel to support and make connections to all components, including roof-mounted equipment specified in other sections. Design shall comply with IBC requirements including load path to structure.

C. Roof steel supporting roof-mounted equipment shall be designed for all seismic and wind forces including, but not limited to, tension, compression and moment loads.
D. Chimneys, stacks and water heater breeching passing through floors are to be attached at each floor level with a riser guide.
E. Where ceilings are not braced, lay-in lighting fixtures, weighing more than 20 lbs, shall have at least 2 independent corner diagonal wire ties to structure.
F. Lay-in ceilings in compliance with seismic code requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel lights and diffusers less than 40 lbs to T-bar structures. Local codes dictate fixture support requirements.

1.8 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

   A. All City, State and Local Codes (Code)

      a. SMACNA Guidelines for Seismic Restraint of Mechanical Systems, Second Edition (Standard reference, to be used for design purposes only, not code)
      b. International Conference of Building Officials (ICBO) (Standard)
      c. International Building Code (Code)
      d. ASHRAE (Standard reference, to be used for design purposes only, not code).
      e. VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code).

B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

C. Use IBC-2021 as reference code standard unless otherwise designated.

SECTION 2 – PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   1. Mason Industries.
   2. Kinetics Noise Control.
   3. Or approved equal.

B. Available Manufacturers:

   1. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer.
   2. The basis of this Specification is The VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics.
   3. Products from other specified manufacturers are acceptable provided their systems strictly

comply with these Specifications and have the approval of the Specifying Engineer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). See Form VL-1 listing other manufacturers to be considered for use on this project.

2.2 VIBRATION ISOLATION TYPES

A. Type A: Spring Isolator – Free Standing
A*

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or ¼" elastomeric acoustical friction pad between the bottom of isolator and the support.
2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
3. Spring diameters shall be no less than 0.8" of the compressed height of the spring at rated load.
4. Springs shall have a minimum additional travel to solid equal to 50% of the operating deflection.

B. Type B: Seismically and Wind Restrained Spring Isolator
MS, MSS, AEQM, ASCM, AMSR

1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position there must be an internal isolation pad or elastomeric cup. Housing shall be designed to resist all seismic forces.

C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type)
HRSA

1. Hangers shall consist of rigid steel frames containing minimum 1 ¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type A. The elastomeric element shall have resilient bushings projecting through the steel box.
2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short-circuiting the spring.
3. Submittals shall include a hanger Drawing showing the 30° capability.
4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.

D. Type D: Elastomer Double Deflection Hanger Isolator
HR

1. Molded (minimum 1 ¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35."

2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

E. Type E: Combination Spring/Elastomer Hanger Isolator
HRS

1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
3. 30° angularity feature is not required.

F. Type F: Seismically Restrained Elastomer Floor Isolator
RSM, MB, RUD

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or Durulene™ Specifications.

G. Type G: Pad Type Elastomer Isolator (Standard)
Maxiflex

1. One layer of ¾" thick elastomeric pad consisting of 2" square modules for size required.
2. Load distribution plates shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

H. Type H: Pad Type Elastomer Isolator (High Density)
Fabri-Flex, NDB, NRC

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.
2. Load distribution plate shall be used as required.
3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

I. Type I: Thrust Restraints
RSHTR, TRK

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to ¼" due to thrust forces. Contractor shall supply hardware.
2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

J. Type J: Pipe Anchors
MDPA, AG

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.
2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

K. Type K: Pipe Guides
PG/AG/SWP/SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum ½" thickness of 60 durometer elastomer.

2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and replaceable to allow for selection of pipe movement.
3. Guides shall be capable of ± 1 5/8" motion, or to meet location requirements.

L. Type L: Isolated Pipe Hanger System
CIH, CIR, TIH, PIH

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

2.3 SEISMIC RESTRAINT TYPES

A. Type I: Spring Isolator, Restrained
MS, MSS, AEQM, ASCM, AMRS

1. Refer to vibration isolation Type B.

B. Type II: Seismically Restrained Elastomer Floor Isolator
MB, RUD

1. Refer to vibration isolation Type F.

C. Type III: All-Directional Seismic Snubber
SR, ER

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of ¼" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to insure no short circuits exist before systems are activated.

D. Type IV: Floor or Roof Anchorage
Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

E. Type V: Seismic Cable Restraints
SB, LRC

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges.

F. Type VI: Rigid Arm Brace
SAB

1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two anchor bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

G. Type VII: Internal Clevis Cross Brace
ICB

1. Internal clevis cross braces at seismic locations shall be pre-cut pipe or other approved device sized for internal dimensions.

H. Type VIII: Seismic Waterproof Foundation Wall Sleeve
SWFWS

1. Seismic waterproof foundation wall sleeves shall consist of two elastomeric sleeves that shall be mounted both inside and out of the vertical foundation wall. The conical design shall have a suitably waterproof means of fastening to both concrete and to its concentric utility pipe. Allowable vertical drift shall be ± 2" from the installed neutral point along the

vertical “y” axis. All fittings shall be stainless steel or galvanized.

2.4 EQUIPMENT BASES

A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4”) for resisting wind and seismic forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

B. Base Types

1. Type B-1: Integral Structural Steel Base
   WFB, SFB, WSB

   a. Rectangular bases are preferred for all equipment.
   b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
   c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
   d. Base depth need not exceed 12” provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
   e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2.”

2. Type B-2: Concrete Inertia Base
   MPF, WPF, CPF

   a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
   b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
   c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6.”
   d. The base depth need not exceed 12” unless specifically recommended by the base manufacturer for mass or rigidity.
   e. Forms shall include a minimum concrete reinforcing consisting of 3/8” bars welded in place a maximum of 16” on centers running both ways in a layer 1 to 1½” above the bottom.
   f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
   g. Height saving brackets shall be employed in all mounting locations to maintain a 2” minimum operational clearance below the base.

3. Type B-3: Seismic Isolation Curb
   P6200, P6300

   Option: Sound Package 1 & 2 VMC/AB-RPFMA/SRPFMA

   a. Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural seismic spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point support for both seismic attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, paragraph 7, Design Seismic Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.
   b. All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or cups.
   c. Hardware must be plated and the springs shall be powder-coated or cadmium-plated.
   d. The curb's waterproofing shall be designed to meet all NRCA requirements.
   e. All spring locations shall have full spring view access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
   f. Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood nailer.

   Option #1 Where sound barrier package is required, curb shall have full size lay in attenuation panels having a minimum STC rating of 60 when combined with the roof deck's rating. Attenuation system shall add a full sound attenuation structural floor to the curb capable of spanning the curb's width and designed for live loads of 20 psf. Panels shall not weigh more than 6 psf. The 4" nominal galvanized panel shall be joined to allow for airtight construction and additionally shall have a support system where the panels are used below an outside condenser section. Panels shall be waterproof for both outdoor and indoor application. The space below the curb panels and the roof deck shall have 4" of insulation Contractor furnished and installed.

   Curb wall construction shall utilize the roofer's standard insulation where curbs use the TAS open thermal acoustical screening system. Solid wall curbs shall use 2" of the factory duct liner installed by the curb manufacturer. The entire curb shall have a continuous neoprene elastomeric air seal. Type RPFMA shall use an open return system with the roof return opening set as far as possible from the unit's return opening.

   Option # 2 When curb type SRPFMA (Supply Return Plenum Construction) is required, in addition to Option # 1 the walls of the supply section will use 2" sound attenuating panels as well as a continuous inner elastomeric air seal and isolated plenum divider. Both supply and return ducts shall seal directly to curb base floor attenuation panels.

4. Type B-4: Seismic Non-Isolated Curbs
   P6000

   Option: Sound Package VMC-RPFMA/SRPFMA System

   a. Seismic curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
   b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

5. Type B-5: Isolated Equipment Supports
   R7200/R7300

   a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B-3.
   b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

6. Type B-6: Non-Isolated Equipment Supports
   R7000

   a. This shall have the same provisions as Type B-5 without the spring isolation.

7. Type B-7: Computer Room Unit Base
   SFS

   a. Computer Room air conditioning units shall be welded or bolted to welded structural steel stands having a minimum 0.5 “G” certified lateral acceleration capabilities, but no less than the design seismic loads.
   b. Elastomeric isolated stands shall have 1” of adjustment to accommodate floor irregularities and 0.25” of nominal static deflection.
   c. Spring isolated stands shall have 1” of adjustment to accommodate floor irregularities and 2” of nominal static deflection.
   d. Bolting or welding is required to meet seismic criteria.
   e. Stands to have positive fastening provisions for bolting of computer room unit to seismic floor stand and fastening of seismic isolated floor stand to structure, capable of carrying the design seismic loads.

8. Type B-8 AHU / AC unit Structural Base Frames

   a. Where roof mounted Air Conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit’s

base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind /seismic restrained isolation system.

b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A". Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.

9. Type B-9: Structural Adapter Curbs

a. Structural Adapter Curbs will be designed to match the replacement unit's curb dimensions to the existing unit's curb dimensions, matching both supply and return air delivery systems of both components or creating a plenum to accommodate airflow of both components.
b. The new adapter curb will be structurally designed to rest on the existing curb only and carry the new unit's load directly to building steel or concrete thru stanchions that are welded or bolted to both within the confines of the existing curb. Additionally, the new roof mounted unit will be welded or bolted to the structural adapter and shall demonstrate load path of all loads from all components into the building structure.
c. Where the installed unit component's height to the unit's electrical disconnect box is in excess of 78", a service platform or other suitable staging shall be utilized.
d. Structural Adapter Curbs shall be Type PSAC-6000 as manufactured by The VMC Group.

10. Type B-10 Structural Isolated Adapter Curbs:

a. Where isolation is required to be incorporated into the adapter curb, isolation and restraining system shall be similar to the requirements highlighted under Base Type B-3. Isolator deflection shall be either 2" or 3" deflection as required by Isolation Table "A". Structural Isolated Adapter Curbs shall be Type PSAC-6200 or PSAC-6300 as manufactured by The VMC Group.

2.5 FLEXIBLE CONNECTORS

A. Type FC-2: Flexible Stainless Steel Hose
SS-FP, SS-FW, SS-PM, SS-WE

1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples.

B. Type BC-2 connector shall be braided bronze for Freon connections.

1. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1 ½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 ½ x 18

6 x 20 8 x 22	16 x 32	1 ¼ x 12

2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

SECTION 3- EXECUTION

3.1 EXAMINATION

A. All areas that will receive components requiring vibration control, seismic or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.

B. Examine all “rough ins” including anchors and reinforcing prior to placement.

3.2 APPLICATIONS

A. All vibration isolators and seismic, wind restraint systems must be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.

B. Installation of vibration isolators and seismic, wind restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system specified herein.

D. The Contractor shall not install any isolated components in a manner that makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate Work with other trades to avoid rigid contact with the building.

F. Overstressing of the building structure must not occur due to overhead support of equipment. Contractor must submit loads to the Structural Engineer of record for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.

G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment or piping.

H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic rigid braces may be used in place of cables on rigidly attached systems.

I. At locations where seismic cable restraints or seismic single arm braces are located, the support rods must be braced when necessary to accept compressive loads. See Table “E.”

J. At all locations where seismic cable braces and seismic cable restraints are attached to the pipe clevis, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.

K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.

L. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraints shall be those described in the Specification when horizontal motion exceeds 3/8."

M. Special and Periodic Inspections for items listed in Section 1.4, Article B shall be conducted and submitted on a timely basis.

3.3 EQUIPMENT INSTALLATION

A. Equipment shall be isolated and/or restrained as per Tables A-E at the end of this section.

B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck to meet acceleration criteria (see Section 1.4). Anchor isolators and/or bases to housekeeping pads. Concrete Work is specified under that section of the Bid Documents.

C. Additional Requirements:

1. The minimum operating clearance under all isolated components bases shall be 2."
2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
3. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free to move in all directions, within the limits of the restraints.
4. Ceilings containing diffusers or lighting fixtures must meet seismic requirements by using earthquake clips of other approved means of positive attachment to secure diffuser and fixtures to T-bar structure.
5. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

3.4 PIPING AND DUCTWORK ISOLATION

A. Vibration Isolation of Piping:

1. HVAC Water Piping: All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type E hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type B isolators. Heat exchangers and expansion tanks are considered

part of the piping run. The first 3 isolators from the isolated equipment shall have at least the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" nominal deflection or greater for pipe sizes up to and including 3," 1 3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2½" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.

2. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B.) Isolator type shall be as listed in Article 1, above.
3. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
4. Gas lines shall not be isolated.
5. Fire protection lines shall not be isolated.

B. Seismic Restraint of Piping:

1. All high hazard and life safety pipe regardless of size such as fire protection mains, gas piping, and piping with an Ip=1.5 shall be seismically restrained or braced. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.
2. Seismically restrain piping, with an Ip = 1.0, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI single arm braces may be used on non-isolated piping.
3. Seismically restrain all other piping 2½" diameter and larger. Type V seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or single arm braces may be used on non-isolated piping.
4. See Table D for maximum seismic bracing distances.
5. Multiple runs of pipe on the same support shall have distance determined by calculation.
6. Rod braces shall be used for all rod lengths as listed in Table E.
7. Clevis hangers shall have braces placed inside of hanger at seismic brace locations.
8. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
9. For all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
10. Transverse restraint for one pipe section may also act as longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe or combined stresses are within allowable limits at longer distances.
11. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VI restraint, if trapeze is smaller than 48" long.
12. Branch lines may not be used to restrain main lines or cross-mains.
13. All fire protection branch lines shall be end tied.

14. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a lateral/transverse brace for pipe sizes up to and including 6," provided fire stopping material is tight to the pipe.
15. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.
16. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.
17. Vertical pipe rises between floors shall have their differential movement part of the seismic design for building drift.
18. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift. (Seismic Restraint Type VIII).

C. Vibration Isolation of Ductwork:

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type A or Type E isolators. Actual spring deflection shall be a minimum of 0.75."
2. All duct runs having air velocity of 1500 feet per minute (fpm) or more shall be isolated from the building structure by Type E combination spring elastomer hangers or Type A floor spring supports. Spring deflection shall be a minimum of 0.75."

D. Seismic Restraint of Ductwork:

1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Type V seismic cable restraints or Type VI single arm braces shall be used on this duct. Duct that serves a life safety function or carries toxic materials in an "Essential or High Hazard Facility" must be braced with no exceptions regardless of size or distance requirements.
2. Restrain round ducts with diameters of 28" or larger. Type V seismic cable restraints or Type VI single arm braces.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
4. See Table D for maximum seismic bracing distances.
5. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
6. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
7. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
8. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.

EXEMPTIONS

A. EQUIPMENT:

1. Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.

2. Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, Ip = 1.0 and there is no possibility of consequential damage.

3. Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an Ip = 1.0 and where flexible connections exist between the component and associated ductwork, piping or conduit.

4. Chain supported lighting fixtures as described in Section 13.6.1 (ASCE 7-05).

B. DUCT (Applies to Ip = 1.0 only)

1. Rectangular, square, and oval air handling ducts less than six square feet in cross sectional area.
2. Round air handling duct less than 28 inches in diameter.
3. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork.

C. PIPING

1. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where Ip = 1.0.
2. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where
   Ip = 1.5.
3. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where Ip = 1.5.
4. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
5. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
6. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7-05).

EXEMPTIONS DO NOT APPLY FOR:

A. LIFE SAFETY or HIGH HAZARD COMPONENTS

1. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2021 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. *(A partial list is illustrated.)* High Hazard is additionally classified as any system handling flammable,

combustible or toxic material. Typical systems not excluded are additionally listed below.

B. ELECTRICAL

1. Includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

C. PIPING

1. Natural gas, or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

D. DUCT

1. Fresh air make up duct connected to emergency system, breeching or as used by the fire department on manual override.

E. EQUIPMENT

1. Previously excluded non-life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

3.5 FIELD QUALITY CONTROL, INSPECTION

A. All Independent Special and Periodic Inspections must be performed and submitted on components as outlined in Section 1.4 B, Article 4. (See also Contractor Responsibility, Section 1.4B, Article 5.) Note: Special Inspection services are to be supplied by the Owner.

B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or list any that require correction. The Contractor shall submit a report to the Architect, including the representative's report, certifying correctness of the installation or detailing Corrective Work to be done.

4.1 SELECTION GUIDE FOR VIBRATION ISOLATION AND SEISMIC RESTRAINT

TABLE "A" HVAC EQUIPMENT										
	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
EQUIPMENT (See Notes)	Size/Type	Mtg	Isol	Nom Defl*	Base	Restr	Isol	Nom Defl*	Base	Restr
Outdoor Condensing Units/Condensers		Roof	---	---	---	IV	B	2.50 Minimum	B-5	IV
Axial Fans (Inline Type)		Floor	B	0.75	---	IV	B	See Guide	---	IV
		Ceiling	---	---	---	---	E	See Guide	---	V
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	B	0.75	B-1	IV	B	See Guide	B-1	IV
	Class 2 & 3	Floor	B	0.75	B-2	IV	B	See Guide	B-2	IV
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	B	0.75	---	IV	B	See Guide	See Note 4	IV
	Class 2 & 3	Ceiling	---	---	---	---	E	See Guide	B-2	V
Condensate Pumps		Floor	F	0.20	If req.	IV	F	0.20	If req.	IV
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	---
Fan Coil Units		Floor	F	0.20	---	IV	B	0.75	---	IV
		Ceiling	---	---	---	---	E	0.75	---	V
Rooftop AHU/AC *(curb mounted)*	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 See Notes 5,6	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-3 See Notes 5,6	---
Rooftop AHU/AC *(dunnage mounted)*	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-8	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-8	---

**See Minimum Deflection Guide for Equipment with Low RPM*

Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"
601 thru 900	1.5"
Greater than 900	0.75"

General Notes for All Tables:

1. Abbreviations:
   (1) Mtg = Mounting
   (2) ol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
   (3) Defl = Minimum Deflection of Vibration Isolator
   (4) Base = Base Type per Section 2.4, Equipment Bases
   (5) Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types
2. All deflections indicated are in inches.
3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
4. For roof applications, use base Type B-5.
5. Specification Option #1 called out on equipment schedule in curb Type B-3 shall use sound barrier RPFMA when there is no concrete under rooftop units and this option is selected. Curbs can be used for return plenums. (See Option #1 under curb type B-3.)
6. Specification Option #2, called out on equipment schedule in curb Type B-3 shall be used where curbs require supply and return sound attenuation package type SPFMA shall be used. (See Option #2 under curb type B-3.)
7. Units may not be capable of point support. Refer to separate air handling unit Specification section. If that section does not provide base and external isolation is required, provide Type B-1 base by this section for entire unit.
8. Static deflection shall be determined based on the deflection guide for Table "A."
9. Deflections indicated are minimums at actual load and shall be selected for manufacturer's nominal 5," 4," 3," 2" and 1" deflection spring series; RPM is defined as the lowest operating speed of the equipment.
10. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."
11. Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5."
12. Indoor utility sets with wheel diameters less than 24" need not have deflections greater than .75."
13. Curb-mounted fans with curb area less than 9 square feet are excluded.
14. For equipment with multiple motors, Horsepower classification applies to largest single motor.

4.2 SPACING CHART FOR SUSPENDED COMPONENTS

Table "D" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved; Conduit and Conduit Racks			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

4.3 VERTICAL HANGER ROD BRACING SCHEDULE

Table "E" Hanger Rod Bracing Schedule (Stiffener to be maximum 6" from end of rod)					
Rod Dia.	Clamp Size	Maximum Un-braced Rod Length	Steel Angle Size	Clamp Spacing	Min # of Clamps per Stiffener
3/8"	SRBC-1-1/4	19"	1 x 1 x ¼"	16"	2
1/2"	SRBC-1-1/4	25"	1 x 1 x ¼"	20"	2
5/8"	SRBC-1-1/4	31"	1 x 1 x ¼"	24"	2
3/4"	SRBC-1-1/2	37"	1 ½ x 1 ½ x ¼"	28"	2
7/8"	SRBC-1-1/2	43"	1 ½ x 1 ½ x ¼"	33"	2
1"	SRBC-1-1/2	50"	1 ½ x 1 ½ x ¼"	40"	2
1 1/8"	SRBC-1-1/2	62"	1 ½ x 1 ½ x ¼"	50"	2

FORM CQAP
FOR USE GROUP III PROJECTS, IBC-2021,
OCCUPANCY CATEGORY IV PROJECTS, IBC-2021

Section 15071
Vibration Isolation and Seismic Restraints

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

Contractor IBC Quality Assurance Seismic Program.

This form is to be filled out as the identifying document for the Contractor's Quality Assurance Program (see Contractor Responsibility section 1.4B article 4) before the first submission in any vendor group by the installing Contractor. All items listed herein shall be part of that program.

1. Acknowledge special requirements contained in the quality assurance plan
2. Acknowledge that control will be exercised to obtain conformance with the construction documents
3. Procedures for exercising control within the Contractor's organization including frequency and distributions of inspections and testing reports
4. Identification and qualification of the persons exercising control of this program within their organization

Contractor to submit this program acknowledging receipt and program implementation. Each of the 4 listed programs are to be submitted including all applicable details as listed above.

_____
Signature

_____
Print Name

FORM CVC-1
FOR USE GROUP III PROJECTS, IBC-2021 &
OCCUPANCY IV PROJECTS, IBC-2021.

Section 15071
Vibration Isolation and Seismic Restraints

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

Notes to the installing Contractor

The purpose of this form is for you, the Contractor to fill in all vendors that are IBC compliant as part of your initial submission for any group of equipment, i.e., fans, ac units, pumps, etc. It is acceptable to submit vendors that will be compliant as long as a factory letter is issued stating full compliance will occur at time of shipment. Only IBC compliant vendors can participate on this project. In the event that no vendor in any group is IBC compliant, this information must be submitted to the project's MEP for approval.

Manufacturer	IBC Compliant	
	Yes	No

_____
Signature

_____
Print Name

FORM SQA-1
FOR USE GROUP III PROJECTS, IBC-2021,
OCCUPANCY CATEGORY IV PROJECTS, IBC-2021.

Section 15071
Vibration Isolation and Seismic Restraints
Seismic Quality Assurance Plan for The Installation of Life Safety
And High Hazard Systems (Inspections)

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

The following are required for the Seismic Quality Assurance Installation Plan for Life Safety and High Hazard systems to be prepared and submitted by each installing Contractor (see Contractor's Responsibilities paragraph 1.4B, article 5). This plan must reflect all of the provisions and reports outlined in the paragraph below. As part of this Contractor's final requisition, this form must accompany, along with all satisfactorily completed tests and reports, the final payment's request including all applicable certification reports.

- Special field inspection and testing is required by IBC Sections 1704, 1707 and 1708 during the installation of Life Safety and High Hazard System components including equipment, piping and all electrical connections. Components must be inspected by a Building Official or approved independent special inspector periodically during the course of installation. Contractor shall submit such inspection reports as part of his project wrap up for each group of equipment, components so requiring this program. All components, which are Life Safety, designate or Handle Hazardous substances fall into this category. Typical Life Safety and High Hazard components as well as non-life safety components listed in that section are outlined in 1.3 B of the SGMEC® Specifications.

_____
Signature

_____
Print Name

END OF SECTION 15071

SECTION 15077 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.03 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.

1.04 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 acoustic ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 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.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules).

C. 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.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Red.

C. Background Color: Black.

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. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 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 partially cover 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.

2.04 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 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.

PART 3 - EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. 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.

B. 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 branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
2. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Heating Water Piping (HWS & HWR):

    a. Background Color: White.
    b. Letter Color: Red.

2. Refrigerant Piping:

    a. Background Color: Blue.
    b. Letter Color: White.

3. Cold Water Make-Up Piping (CW):

    a. Background Color: White.
    b. Letter Color: Green.

4. Boiler Feed Piping (BF):

a. Background Color: Black.
b. Letter Color: White.

5. Pumped Low-Pressure Steam Condensate Piping (PC):

a. Background Color: Black.
b. Letter Color: White.

6. Low-Pressure Steam Piping (LPS):

a. Background Color: Black.
b. Letter Color: White.

7. Low-Pressure Steam Condensate Piping (LPC):

a. Background Color: Black.
b. Letter Color: Blue.

8. Gas Piping

    a. Background Color: White.
    b. Letter Color: Yellow.

3.04 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. Refrigerant: 1-1/2 inches, Diamond.
    b. Hot Water: 1-1/2 inches, square.
    c. Gas: 1-1/2 inches square.

2. Valve-Tag Color:

    a. Refrigerant: Green.
    b. Hot/Chilled Water: Natural.
    c. Gas: Yellow.

3. Letter Color:

    a. Refrigerant: Black.
    b. Hot/Chilled Water: Black.
    c. Gas: White.

3.05 WARNING-TAG INSTALLATION

A. Write the required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15077

SECTION 15081 - DUCT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, supply and outdoor air.
2. Indoor, return air.
3. Outdoor, exposed supply and return.

B. Related Sections:

1. Division 15 Section "HVAC Piping Insulation."
2. Division 15 Section "Metal Ducts" for duct liners.

1.03 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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

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.

1.04 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.

1.05 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.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.07 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

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

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 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.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR 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. 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, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. 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.; CrimpWrap.
    b. Johns Manville; MicroFlex.
    c. Knauf Insulation; Pipe and Tank Insulation.
    d. Manson Insulation Inc.; AK Flex.
    e. Owens Corning; Fiberglas Pipe and Tank Insulation.
    f. Or approved equal.

2.02 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 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, provide one of 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; 85-50.
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.

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.
c. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.
e. 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
d. 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.
f. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.
d. Or approved equal.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.
e. 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.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

b. 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: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

2.06 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.
    e. Or approved equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.

D. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

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. Polyguard Products, Inc.; Alumaguard 60.
b. Venture Clad 1577 CW.
c. Or approved equal.

2.08 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. 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. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 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.

C. 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, provide one of 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.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of 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.

2.09 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
   c. Or approved equal.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015-inch-thick, 3/4 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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.; CHP-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 Perforated Base Insul-Hangers.
      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: Stainless 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. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-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.

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 one of the following:

a. C & F Wire.

b. Or approved equal.

2.010 CORNER ANGLES

A. Stainless-Steel Corner Angles: 0.024-inch-thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 316.

PART 3 - EXECUTION

3.01 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. 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. 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 duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

3.04 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: 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 07 Section "Penetration Firestopping "firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. 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 over compress 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 one edge and one 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 two 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.

B. 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 over compress 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 one edge and one 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 two 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.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.07 FINISHES

A. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD QUALITY CONTROL

A. 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.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, supply and outdoor air.
2. Indoor, return and exhaust.
3. Outdoor, 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.

3.010 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density, minimum R-6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density, minimum R-6.

B. Return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density, minimum R-6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density, minimum R-6.

C. Outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density, minimum R-6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density, minimum R-6.

D. Exhaust-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density, minimum R-6.
2. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. nominal density, minimum R-6.

3.011 ABOVEGROUND, OUTDOOR (OR ATTIC DUCT) AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density, minimum R-8.

C. Return-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density, minimum R-8.

D. Outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density, minimum R-8.

3.012 INDOOR, 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. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:

1. PVC, Color- As selected by Architect: 20 mils thick.

3.013 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. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. VentureClad 1577CW (All Finishes). Contractor shall install as per strict manufacturer's installation instructions, recommendations, and requirements.

D. Ducts and Plenums, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. VentureClad 1577CW (All Finishes). Contractor shall install as per strict manufacturer's installation instructions, recommendations, and requirements.

END OF SECTION 15081

SECTION 15082 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following HVAC equipment that is not factory insulated:

1. Heating, hot-water pumps.
2. Expansion/compression tanks.
3. Air separators.
4. Piping system filtration unit housings.

B. Related Sections:

1. Section 15 "Duct Insulation."
2. Section 15 "HVAC Piping Insulation."

1.03 ACTION 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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

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 removable insulation at equipment connections.
4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.
7. Detail paintable surfaces - Critical for exposed areas – Architect to select colors.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Sheet Form Insulation Materials: 12 inches square.
3. Sheet Jacket Materials: 12 inches square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. 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.

C. Field quality-control reports.

1.05 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.

1.06 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.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.08 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

2.01 INSULATION MATERIALS

A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. K-Flex USA.
    d. Or approved equal.

G. 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 II with factory-applied vinyl jacket or Type III with factory-applied FSK or FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Knauf Insulation.

c. Owens Corning.
d. Or approved equal.

H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or approved equal.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or approved equal.

J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or approved equal.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.
e. 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-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or approved equal.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ramco Insulation, Inc.
b. Or approved equal.

2.03 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Foster Brand; H. B. Fuller Construction Products.
b. Or approved equal.

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Falle Bridges.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Or approved equal.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA.
    b. Armaflex.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. U-Flex.
    e. Or approved equal.

E. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Or approved equal.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand.
    b. Eagle Bridges.
    c. Foster Brand.
    d. Or approved equal.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96/E 96M, 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, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Or approved equal.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Vimasco Corporation.
    d. Or approved equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Vimsco Corp.
    d. Or approved equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.07 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Manufacturers: Subject to compliance with requirements, provide products by the following:

        1) ITW Insulation Systems; Illinois Tool Works, Inc.
        2) Or approved equal.

6. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) ITW Insulation Systems; Illinois Tool Works, Inc.
2) Or approved equal.

7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) ITW Insulation Systems; Illinois Tool Works, Inc.
2) Or approved equal.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Or approved equal.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for equipment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster Brand; H. B. Fuller Construction Products.
b. Vimasco Corporation.
c. Or approved equal.

2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Alpha Associates, Inc.
    b. Or approved equal.

2.010 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. P.I.C. Plastics, Inc.
    c. Proto Corporation.
    d. Speedline Corporation.
    e. Or approved equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Paintable - Color as selected by Architect.
4. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ITW Insulation Systems; Illinois Tool Works, Inc.
    b. RPR Products, Inc.
    c. Or approved equal.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Option 1: Sheet and roll stock ready for shop or field sizing.
    b. Option 2: Factory cut and rolled to size.
    c. Finish and thickness are indicated in field-applied jacket schedules.

d. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
e. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
f. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Option1: Sheet and roll stock ready for shop or field sizing.
b. Option 2: Factory cut and rolled to size.
c. Material, finish, and thickness are indicated in field-applied jacket schedules.
d. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
e. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper or 2.5-mil- thick polysurlyn.
f. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white or stucco-embossed aluminum-foil facing.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Polyguard Products, Inc.
b. Or approved equal.

F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. Or approved equal.

G. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. Or approved equal.

H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. Or approved equal.

2.011 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Venture Tape.
b. 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. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Venture Tape.
    b. 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.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Venture Tape.
    b. 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.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Venture Tape.
    b. 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.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. Or approved equal.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. Or approved equal.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.012 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ITW Insulation Systems; Illinois Tool Works, Inc.
   b. RPR Products, Inc.
   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, 3/4 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, 3/4 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        4) Nelson Stud Welding.
        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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) CL WARD & Family Inc.
        3) Gemco.
        4) Midwest Fasteners, Inc.
        5) Nelson Stud Welding.
        6) 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.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        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 or Aluminum or Stainless 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.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Gemco.
2) Midwest Fasteners, Inc.
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.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.
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 or Aluminum or Stainless 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 or aluminum or stainless-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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        4) Nelson Stud Welding.
        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. Manufacturers: Subject to compliance with requirements, provide products by 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 the following:

    a. C & F Wire.
    b. Or approved equal.

2.013 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.01 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 and equipment 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.

3.02 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.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. 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. 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.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. 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.

O. 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.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    d. Do not overcompress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. 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.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make

taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.060 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.05 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.06 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09900 "Exterior Painting" and Section 09900 "Interior Painting."

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. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: 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(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.08 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Insulation shall comply with ASHRAE 90.1-2013.

D. Heating-hot-water pump insulation shall be one of the following:
   1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

E. Heating-hot-water expansion/compression tank insulation shall be one of the following:
   1. Mineral-Fiber Board: 1 inch thick and 6-lb/cu. ft. nominal density.
   2. Mineral-Fiber Pipe and Tank: 1 inch thick.

F. Heating-hot-water air-separator insulation shall be one of the following:
   1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
   2. Mineral-Fiber Pipe and Tank: 2 inches thick.

G. Piping system filter-housing insulation shall be one of the following:
   1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.
   2. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.09 INDOOR, 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. Equipment, Concealed:

1. None.
2. PVC, Color-Coded by System: 20 mils thick.
3. Painted Aluminum, Smooth or Corrugated or Stucco Embossed: 0.020 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. None.
2. PVC, Color-Coded by System: 20 mils thick.
3. Painted Aluminum, Smooth or Corrugated or Stucco Embossed: 0.020 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. None.
2. Painted Aluminum, Smooth or Stucco Embossed with 1-1/4-Inch- Deep Corrugations or 2-1/2-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.032 inch thick.

3.010 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. Equipment, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Painted Aluminum, Smooth or Corrugated or Stucco Embossed: 0.032 inch thick.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:

1. Painted Aluminum, Smooth or Corrugated or Stucco Embossed with Z-Shaped Locking Seam: 0.032 inch thick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Painted Aluminum, Smooth or Stucco Embossed with 1-1/4-Inch- Deep Corrugations or 2-1/2-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.040 inch thick.

END OF SECTION 15082

SECTION 15088 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Refrigerant suction and hot-gas piping, indoors and outdoors.
2. Condensate Drain Piping.
3. Hydronic Piping

1.03 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. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail application of field-applied jackets.

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.

1.04 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 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 agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.05 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.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports for HVAC 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.

1.07 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

2.01 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. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

    a. Aeroflex
    b. Armacell
    c. K-flex
    d. Or approved equal.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include 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. 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.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

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. Ramco Insulation, Inc.; Super-Stik.
    b. Or approved equal.

2.03 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 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 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, available products that may be incorporated into the Work include 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; 85-50.
    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.

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

    a. Aeroflex USA, Inc.; Aeroseal.
    b. Armacell LLC; Armaflex 520 Adhesive.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    d. K-Flex USA; R-373 Contact Adhesive
    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.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    b. Vimasco Corporation; 749.
    c. Or approved equal.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 permat 43-mildry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. 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-50 AHV2.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    c. Vimasco Corporation; 713 and 714.
    d. Or approved equal.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F
5. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.
    f. Or approved equal.

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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

b. 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: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

2.07 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

        2) Or approved equal.

6. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.
e. Or approved equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.09 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, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015-inch-thick, 1/2 inch3/4-inch-wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 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.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 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. Manholes.

5. Handholes.
6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

3.05 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. Stencil or 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. 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.

3.06 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 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.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 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.

3.09 INDOOR PIPING INSULATION SCHEDULE

A. Pipe insulation shall meet or exceed ASHRAE 90.1-2013 minimum piping insulation thicknesses.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1-1/4” and Smaller Pipe Size: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1.5 inch thick.

2. NPS 1-1/2” and Larger Pipe Size: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2.0 inch thick.

C. Refrigerant Suction, Hot-Gas Piping, Liquid, and Condensate Drain:

1. Less than 1” Pipe Size: Insulation shall be the following:

a. Flexible Elastomeric: 3/4” inch thick.

2. 1” and Larger Pipe Size: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.010 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction, Hot-Gas Piping, Liquid and Condensate Drain:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1” inch thick.

2. Provide manufacturer’s outdoor finish for weather and UV protection (water-based latex enamel - minimum 2 coats).

3.011 INDOOR, 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. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 20 mils thick.

3.012 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. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 30 mils thick

END OF SECTION 15088

SECTION 15110 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following general-duty valves:

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Gate valves.
5. Globe valves.

B. Related Sections include the following:
1. Section, 15077 “Identification for HVAC Piping & Equipment".
2. Section, 15900 - HVAC Instrumentation & Controls".
3. Piping Sections for specialty valves applicable to those Sections only.

1.03 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. TFE: Tetrafluoroethylene plastic.

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 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 gate and globe valves closed to prevent rattling.
4. Set ball 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

2.01 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.

2.02 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.

a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.03 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Copper-Alloy Ball Valves:

a. Hammond Valve.
b. Milwaukee Valve.
c. NIBCO INC.
d. RuB, Inc (Dietrich Associates).
e. Stockham Valves & Fittings.
f. Or approved equal.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full or regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.04 FERROUS-ALLOY BALL VALVES

A. Manufacturers:

1. Hammond Valve.
2. Milwaukee Valve.
3. NIBCO INC.
4. Stockham Valves & Fittings
5. Or approved equal.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 150 or Class 300, full or regular port.

2.05 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Bray Controls; a division of Bray International.
c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Tyco Valves & Controls; a unit of Tyco Flow Control.
k. 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: Carbon steel, cast iron, ductile steel, or stainless steel.
e. Seat: Reinforced PTFE or metal.
f. Stem: Stainless steel; offset from plane seat.
g. Disc: Carbon steel.
h. Service: Bidirectional.

2.06 BRONZE CHECK VALVES

A. Manufacturers:

1. Bronze Check Valves:

    a. Hammond Valve.
    b. Milwaukee Valve.
    c. NIBCO INC.
    d. Stockham Valves & Fittings.
    e. Or approved equal.

B. Bronze Check Valves, General: MSS SP-80.

C. Type 3, Class 125, 150, or 200 as required, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

D. Type 4, Class 125, 200, or 200 as required, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.07 GRAY-IRON SWING CHECK VALVES

A. Manufacturers:

1. Gray-Iron Swing Check Valves:

    a. Hammond Valve.
    b. NIBCO INC.
    c. Milwaukee Valve.
    d. Stockham Valves & Fittings.
    e. Or approved equal.

B. Gray-Iron Swing Check Valves, General: MSS SP-71.

C. Type I, Class 125 or 250 as required, gray-iron, swing check valves with metal seats.

D. Type II, Class 125 or 250 as required, gray-iron, swing check valves with composition to metal seats.

2.08 BRONZE GATE VALVES

A. Manufacturers:

1. Bronze Gate Valves:

    a. Hammond Valve.
    b. NIBCO INC.
    c. Milwaukee Valve.
    d. Stockham Valves & Fittings.
    e. Or approved equal.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.09 CAST-IRON GATE VALVES

A. Manufacturers:

1. Cast-Iron Gate Valves:

a. Hammond Valve.
b. NIBCO INC.
c. Milwaukee Valve.
d. Stockham Valves & Fittings.
e. Or approved equal.

B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

D. Class 125, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

E. Class 250, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

F. Class 250, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

2.010 BRONZE GLOBE VALVES

A. Manufacturers:

1. Bronze Globe Valves:

a. Hammond Valve.
b. NIBCO INC.
c. Milwaukee Valve
d. Stockham Valves & Fittings
e. Or approved equal.

B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 125, 150, or 200 as required, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.

D. Type 2, Class 125, 150, or 200 as required, Bronze Globe Valves: Bronze body with nonmetallic, PTFE or TFE disc and union-ring bonnet.

E. Type 3, Class 125, 150, or 200 as required, Bronze Globe Valves: Bronze body with bronze disc and renewable seat. Include union-ring bonnet.

2.011 CAST-IRON GLOBE VALVES

A. Manufacturers:

1. Cast-Iron Globe Valves:

a. Hammond Valve.
b. NIBCO INC.
c. Milwaukee Valve.
d. Stockham Valves & Fittings.
e. Or approved equal.

B. Cast-Iron Globe Valves, General: MSS SP-85.

C. Type I, Class 125 or 250 as required, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

2.012 CHAINWHEEL ACTUATORS

A. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.
3. Or approved equal.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron or Cast iron or Aluminum or Bronze, of type and size required for valve. Include zinc coating.
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
3. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service: Ball, butterfly, or globe valves.
3. Pump Discharge: Check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Gate Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
6. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, OS&Y, bronze-mounted cast iron.
7. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
8. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

D. Heating Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
4. Butterfly Valves, NPS 3 and Larger. See Part 2 of the Specification for details.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
6. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, OS&Y, bronze-mounted cast iron.
8. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
9. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

E. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.03 VALVE INSTALLATION

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.04 JOINT CONSTRUCTION

A. Refer to Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 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.

END OF SECTION 15110

SECTION 15127 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of meter and gage, from manufacturer.

D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Trerice, H. O. Co.

b. Or approved equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Aluminum or brass and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, 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.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Trerice, H. O. Co.
    b. Weiss Instruments, Inc.
    c. Or approved equal.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
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.

2.02 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.03 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 or CSA.
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.

2.04 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 available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ernst Flow Industries
    b. Trerice, H. O. Co.
    c. AMETEK, Inc.; U.S. Gauge.
    d. Weiss Instruments, Inc.
    e. Or approved equal.

2. Standard: ASME B40.100.
3. Case: Liquid-filled or Open-front, pressure relief type(s); cast aluminum; 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.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.05 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. Valves: Brass ball, Brass or stainless-steel needle], with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.06 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Company, Inc.
3. Trerice, H. O. Co.
4. 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.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending into fluid 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 remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install test plugs in piping tees.

L. Install flow indicators in piping systems in accessible positions for easy viewing.

M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

N. Install flowmeter elements in accessible positions in piping systems.

O. Install wafer-orifice flowmeter elements between pipe flanges.

P. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

Q. Install permanent indicators on walls or brackets in accessible and readable positions.

R. Install connection fittings in accessible locations for attachment to portable indicators.

S. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

T. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Inlet and outlet of each hydronic coil in air-handling units.
4. Two inlets and two outlets of each hydronic heat exchanger.

U. Install pressure gages in the following locations:

1. Suction and discharge of each secondary pump.

3.02 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be the following:

1. Compact-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be the following:

1. Compact-style, liquid-in-glass type.

C. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:

1. Compact Industrial-style, liquid-in-glass type.

D. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:

1. Compact Industrial-style, liquid-in-glass type.

3.03 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.04 PRESSURE-GAGE SCHEDULE

A. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Liquid-filled Open-front, pressure-relief.

3.05 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

END OF SECTION 15127

SECTION 15181 - HYDRONIC PIPING & SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 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 piping.
3. Safety-valve-inlet and -outlet piping.
4. Makeup-water piping

B. Related Sections include the following:

1. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.03 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: 150 psig at 200 deg F.
2. Makeup-water piping: 80 psig at 150 deg F
3. Condensate drain piping: 150 deg F
4. Air-Vent piping: 200 deg F
5. Safety valve inlet and outlet piping: equal to the pressure of the piping system to which it is attached.

1.04 SUBMITTALS

A. Product Data: For each type of the following:

1. Fittings.
2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
3. Air control devices.
4. Chemical treatment.

5. 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. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.05 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. Pipe 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.

1.06 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (aboveground.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (belowground and within slabs.

C. Wrought-Copper Unions: ASME B16.22.

2.02 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. 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.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. 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.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 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 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. Hart Industries International, Inc.
    d. Jomar International Ltd.
    e. Matco-Norca, Inc.
    f. McDonald, A. Y. Mfg. Co.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    h. Wilkins; a Zurn company.
    i. Or approved equal.

2. Description:
    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 125 psig minimum at 250 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Matco-Norca, Inc.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    e. Wilkins; a Zurn company.
    f. Or approved equal.

2. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 125 psig minimum at 250 deg F
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following]:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.

c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. 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.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elster Perfection.
b. Grinnell Mechanical Products.
c. Matco-Norca, Inc.
d. Precision Plumbing Products, Inc.
e. Or approved equal.

2. Description:

a. Standard: IAPMO PS 66
b. Electroplated steel nipple, complying with ASTM F 1545.
c. Pressure Rating: 300 psigat 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

2.04 VALVES

A. Gate, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 15 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 15 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.

c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.
g. Or approved equal.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.
g. Tour & Andersson; available through Victaulic Company.
h. Or approved equal.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
g. Or approved equal.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
g. Or approved equal.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flow Design Inc.
b. Griswold Controls.

c. Or approved equal.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 250 deg F

2.05 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. Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

E. Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and 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.

F. 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.

G. In-Line Air Separators:
1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

H. Air Purgers:
1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.06 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.07 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2and smaller; flanged ends for NPS 2-1/2and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. 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.

E. Expansion fittings are specified in Division 15 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating-water piping aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Type L, drawn-temper copper tubing, wrought-copper fittings, and pressure-seal joints.
3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. Type ERW piping shall not be accepted.

C. Hot-water heating-water piping, installed belowground and within slabs:

1. Type K, annealed-temper copper tubing, wrought-copper fittings, and brazed joints. Use the fewest possible joints.

D. Makeup-water piping installed aboveground shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
2. Type L, drawn-temper copper tubing, wrought-copper fittings.

E. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Air-Vent Piping:
1. Inlet: Same as service where installed.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. 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.

3.02 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 throttling-duty 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.

3.03 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 3/4ball valve, and short NPS 3/4threaded 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 valves according to Division 15 Section "General-Duty Valves for HVAC Piping."

P. Install unions in piping, NPS 2and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install flanges in piping, NPS 2-1/2and larger, at final connections of equipment and elsewhere as indicated.

R. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4nipple and ball valve in blowdown connection of strainers NPS 2and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

S. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 15 Section "Expansion Fittings and Loops for HVAC Piping."

T. Identify piping as specified in Division 15 Section "Identification for HVAC Piping and Equipment."

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for HVAC Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Escutcheons for HVAC Piping."

X. Fire caulk/smoke seal all piping penetrations of walls, ceilings, and floors as required by Division 7 Section “Penetration Firestopping.”

3.04 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. 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.

D. 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, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.

E. 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, 9feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10feet; minimum rod size, 3/8 inch.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 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. Copper tubing shall be cut square to permit proper joining with fittings.

E. 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.

F. 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.

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 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.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

J. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Insure that sealing elements and grip rings (2-1/2” to 4”) are in place and free from damage. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. Leave insertion marks on pipe after assembly.

3.06 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.

3.07 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 15 Section "Meters and Gages for HVAC Piping."

3.08 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 100 ppm. Modify this value if closed system contains glycol.
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 0.20 ppm.
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
8. Total Suspended Solids: Maximum 10 ppm.
9. Ammonia: Maximum 20 ppm.
10. Free Caustic Alkalinity: Maximum 20 ppm.
11. Microbiological Limits:

    a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
    c. Nitrate Reducers: 100 organisms/ml.

B. 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.

C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.09 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.
7. If pressure sealed fittings are used the system shall be tested per fitting manufacturers requirements.

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, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 15181

SECTION 15189 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes water-treatment systems for the following:

1. Heating, hot-water piping (closed-loop system).
2. Closed circulating water system related to HVAC.
3. Heating and condensate piping.
4. Steam and condensate piping for humidifiers (open systems).

B. Related Sections include the following:

1. Section "Water Softeners" for water treatment in hydronic and steam and condensate piping.

1.03 CHEMICAL FEED SYSTEM DESCRIPTION

A. Closed-Loop System: One bypass feeder on each system with isolating and drain valves downstream from circulating pumps, unless otherwise indicated.

1. Introduce chemical treatment through bypass feeder when required or indicated by test.

B. Open-Loop Systems for Humidifiers: Drip feeders or Polypropylene mesh bags or PVC tubing with hole to feed chemical.

1. Conductivity controller samples sump water when activated by pump and operates solenoid bleed-off valve in line to drain.

1.04 PERFORMANCE REQUIREMENTS

A. Maintain water quality for HVAC systems that controls corrosion and build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.

B. Base chemical treatment performance requirements on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1. Closed System: Maintain system essentially free of scale, corrosion, and fouling to sustain the following water characteristics:

   a. pH: 8 to 9.

2. Small, Open Systems for Humidifiers, Air Washers, Evaporative Condensers, and Cooling Towers: Maintain system essentially free of scale, total suspended solids, and fouling to sustain the following water characteristics:

   a. pH: 8 to 9

1.05 SUBMITTALS

A. Product Data: Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and furnished products listed below:

1. Pumps.
2. Control equipment and devices.
3. Test equipment.
4. Filters.

B. Shop Drawings: Detail equipment assemblies indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Detail power and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Maintenance Data: For pumps, agitators, filters, system controls, and accessories to include in maintenance manuals specified in Division 1.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the chemical treatment manufacturer for both installation and maintenance of chemical treatment equipment required for this Project.

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.

1.07 MAINTENANCE

A. Scope of Service: Provide chemicals and service program for maintaining optimum conditions in the circulating water for inhibiting corrosion, scale, and organic growths in the following:

1. Heating hot-water piping.
2. Steam and condensate system for humidifier applications.
3. Equipment.

B. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, including the following:

1. Initial water analysis and recommendations.
2. Startup assistance.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical assistance.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

1.08 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. Chemicals: Furnish quantity equal to 50% percent of amount initially installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HVAC Water-Treatment Products:

a. Aqua-Chem, Inc.; Cleaver-Brooks Div.
b. Neptune Chemical Pump Company, Inc.
c. Trane Boland Services; Water Treatment.
d. Or approved equal.

2.02 BYPASS FILTER FEEDER

A. Manufacturer & Model: Neptune FTF-5HP with 5-micron filter and leg set or approved equal.

B. Provide bypass filter feeder(s) with a capacity of 5-gallons for each:

1. Hot water heating system.
2. Closed circulating water system related to HVAC.

C. The feeder shell shall be constructed of 10-gauge steel minimum for 5-gallon and larger units. Tank heads shall be minimum 9-gauge steel for 5-gallon units. The bypass feeder shall be rated at 300 psi and to 200 degrees F.

D. The tank shall have a wide mouth, 3-1/2” opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures using partial threads or lugs shall not be considered. Closures rated less than 300 psi shall not be considered equal.

E. The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using “o” rings or gaskets, which are glued or restrained from free movement by snap rings, shall not be considered equal.

F. Required Accessories:

1. Legs – The bypass feeder shall be provided with legs to elevate the feeder off the floor. The legs shall have holes to allow mounting by anchor bolts.
2. Filter (provide one of the two filter accessories):

a. Bag Filter – The bypass feeder shall be provided with a 5-micron filter bag fully supported by a stainless-steel filter basket for simultaneous side stream filtering.

b. Cartridge Filter – The bypass feeder shall be provided with a 5-micron cartridge filter for simultaneous side stream filtering.

2.03 CHEMICAL FEEDING EQUIPMENT

A. Drip Feeders: Plastic reservoir with capillary tubing probe, weight, charging syringe, and clip.

B. Positive-Displacement Diaphragm Pump (for normal operating pressures): Simplex, self-priming, rated for intended chemical with 25 percent safety factor for design pressure and temperature.

1. Adjustable flow rate.
2. Thermoplastic construction.
3. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor. Comply with requirements in Section “Motors.”
4. Built-in relief valve.

C. Positive-Displacement Piston Pump (for higher operating pressures): Metal and thermoplastic construction.

1. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor. Comply with requirements in Section “Motors.”
2. Built-in relief valve.

D. Chemical Solution Tanks: Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with graduated markings.

1. Molded fiberglass cover with recess for mounting pump, agitator, and liquid-level switch.
2. Capacity: 30 gal. or 50 gal.

E. Agitator: Direct drive, 1750 rpm, mounted on tank with angle adjustment.

1. Fully enclosed, continuous-duty, 120-V, 60-Hz, single-phase motor. Comply with requirements in Section “Motors.”
2. Stainless-steel clamp and motor mount, with stainless-steel shaft and propeller.

F. Liquid-Level Switch: Polypropylene housing, integrally mounted PVC air trap, receptacles for connection to metering pump, and low-level alarm.

G. Packaged Conductivity Controller: Solid-state circuitry, 5 percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control-function light, output to control circuit, and recorder.

H. Cold-Water Meter: Positive-displacement type with sealed, tamperproof magnetic drive; impulse contact register; single-pole, double-throw, dry-contact switch.

1. Rotating-disc (for small units) or Turbine (for larger units) type with bronze or cast-iron body rated for 125 psig.
2. Magnetic-drive or mechanical-impulse contactor matched to signal receiver.
3. At least six-digit totalizers.
4. 120-V ac.

I. Solenoid Valves: Forged-brass body, globe pattern, and general-purpose solenoid enclosure with 120-V, continuous-duty coil.

J. Electronic Timers: 150-second and 5-minute ranges, with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.

K. Chemical Tubing: Schedule 40, PVC with solvent-cement joints; or polypropylene tubing with heat fusion.

L. Plastic Ball Valves: Rigid PVC or CPVC body, integral union ends, and polytetrafluoroethylene seats and seals.

M. Plastic-Body Strainer: Rigid PVC or CPVC with cleanable stainless-steel strainer element.

N. Condenser Water-Treatment Control Panel: Incorporate solid-state integrated circuits and digital LED displays, in NEMA 250, Type 12 enclosure with gasketed and lockable door.

1. Control dissolved solids, based on conductivity, and include the following:

    a. Digital readout display.
    b. Temperature-compensated sensor probe adaptable to sample stream manifold.
    c. High, low, and normal conductance indicator lights.
    d. High or low conductance alarm light, trip points field adjustable; with silence switch.
    e. Hand-off-auto switch for solenoid bleed-off valve.
    f. Bleed-off light to indicate valve operation.
    g. Internal adjustable hysteresis or dead band.

2. Control inhibitor feeding, based on makeup volume, and include the following:

    a. Solid-state reset counter (accumulator), with selections from 1 to 15.
    b. Solid-state timer, adjustable from 15 to 300 seconds.
    c. Test switch.
    d. Hand-off-auto switch for chemical pump.
    e. Illuminated legend to indicate feed when pump is activated.
    f. Solid-state lockout timer, adjustable from 15 to 180 minutes, with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
    g. Electromechanical-type, panel-mounted makeup totalizer to measure amount of makeup water.

3. Control biocide with an adjustable time programmer and include the following:

    a. 24-hour timer with 14-day skip feature to permit activation any hour of day.

b. Precision, solid-state, bleed-off lockout timer (zero to nine hours) and clock-controlled biocide pump timer (zero to two and one-half hours). Prebleed and bleed lockout.
c. Solid-state alternator to enable the use of two different formulations.
d. 24-hour digital display of time of day.
e. 14-day LED display of day of week.
f. Fast and slow internal clock set controls.
g. Battery backup so clock is not disturbed by power outages.
h. Quartz timekeeping accuracy.
i. Hand-off-auto switches for biocide pumps.
j. Biocide A and Biocide B illuminated legends to indicate pump is running.

2.04 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer recommended equipment and chemicals, in a carrying case, for testing pH, total dissolved solids, dissolved oxygen, biocount, chloride, and total alkalinity and for calcium hardness field tests.

B. Corrosion Test Coupon Assembly: Constructed of corrosion material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test coupon assembly.

1. **Two**-station rack for closed-loop systems.
2. **Four**-station rack for open condenser water systems.

2.05 CHEMICALS

A. Furnish chemicals recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment.

B. System Cleaner: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

C. Biocide: Chlorine release agents or microbiocides.

D. Closed-Loop, Water Piping Chemicals: Sequestering agent to reduce deposits and adjust pH, corrosion inhibitors, and conductivity enhancers.

E. Heating Steam and Condensate Piping Chemicals: Sequestering agent to reduce hardness and prevent feedline congestion and to provide alkalinity, oxygen scavenger, carbon-dioxide neutralizer, and filming amines.

F. Open-Loop, Condenser Water Piping Chemicals: Sequestering agent to inhibit scaling, acid to reduce alkalinity and pH, corrosion inhibitor, and biocide.

G. Open-Loop Piping Chemicals Serving Humidifiers, Air Washers, Evaporative Condensers, Small Cooling Towers, and Liquid Coolers: Sequestering agent to inhibit scaling, corrosion inhibitor, and biocide nonoxidizing.

2.06 HOT-WATER FILTRATION UNIT

A. Filtration Unit: Stainless-steel housing and polypropylene filter with polypropylene core.

B. Replaceable Filter Media: Compatible with antifreeze and water-treatment chemicals.

C. Filter Media for Sediment Removal Service: Rated at 98 percent efficiency for 20-micrometer particulate.

D. Pressure Drop through the Filter Cartridge: Not to exceed manufacturer’s recommended pressure drop at design-flow rate when clean, and manufacturer’s maximum pressure drop when filter is dirty.

PART 3 - EXECUTION

3.01 WATER ANALYSIS

A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to maintain the water quality as specified in "Performance Requirements" Article.

3.02 INSTALLATION

A. Install treatment equipment level and plumb.

B. Add cleaning chemicals as recommended by manufacturer.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other mechanical Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Confirm applicable electrical requirements in Electrical Sections for connecting electrical equipment.

D. Ground equipment.

1. 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.

3.04 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

B. Test chemical feed piping as follows:

1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose Work that has been covered or concealed before it has been tested and approved.
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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
6. Prepare test reports, including required corrective action.

3.05 ADJUSTING

A. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D 3370 and the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform two separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 60 days apart. Submit written reports of water analysis.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

B. Review manufacturer's safety data sheets for handling of chemicals.

C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout" or Division 1 Section "Operation and Maintenance Data."

D. Schedule at least four hours of training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 15189

SECTION 15198 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.02 FLOOR PLATES

A. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 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. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: cast-brass or split-casting brass type with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: stamped-steel type split-plate, stamped-steel type with concealed hinge.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

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.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 15198

SECTION 15725 - INDOOR 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes constant-volume or variable-volume, air-handling units with fans, coils, filters, and dampers for indoor installations.

1.3 SUBMITTALS

A. Product Data: For each type of air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Wiring Diagrams: Power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain air-handling units through one source from a single manufacturer.

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. NFPA Compliance: air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

D. ARI Certification: air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

E. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate installation with Section 15 "Vibration Isolation and Seismic Restraints."

B. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trane.
   2. Carrier.
   3. Or approved equal

2.2 MANUFACTURED UNITS

A. The air handler shall be furnished as a horizontal draw-through dual temperature water coil.

2.3 CABINET

A. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 500-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. All panels shall be 2-inch double wall construction to facilitate cleaning of unit interior. Casing deflection shall not exceed .005-inch deflection per linear inch under negative or positive pressure, up to unit 6" of pressure.

C. Unit floor shall be of sufficient strength to support 300-lb load during maintenance activities, and shall deflect no more than .005-inches when sitting on a support structure.

D. Panel insulation shall provide a minimum thermal resistance (R) value of 13 ft^2*h*F/Btu throughout the entire unit. Insulation shall completely fill the panel cavities in all directions so that no voids exist and settling of insulation is prevented. Panel assembly shall comply with NFPA 90A.

E. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

F. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.4 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

C. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

D. Handle hardware shall be designed to prevent unintended closure.

E. Access doors shall be hinged and removable without the use of specialized tools to allow.

F. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

2.5 FAN SECTION

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.04.

B. Direct drive fans provided with ECM motors shall have a welded-aluminum impeller that is dynamically balanced as an assembly. Fan shall be maintenance free throughout its operating life. Fans shall be balanced to G6.3 per AMCA 204. No

vibration isolation is necessary. Motor contains integrated PID controller and accepts 0-10VDC input for variable speed control.

1. Fan shall be maintenance free throughout its operating life
2. Fans shall be balanced to a G6.3 per AMCA 204. No vibration isolation base is necessary
3. Access to motor and fan assembly though hinged access door must be provided. Access door shall be sized for removal of entire motor and fan assembly.
4. Motor shall contain integrated PID controller and accept a 0-10VDC input signal for variable speed control.
5. Motorized impeller fans shall be rated in accordance with AHRI Standard 430.

2.6 BEARINGS AND DRIVES

A. Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

B. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

C. V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves selected so required RPM is obtained with sheaves set at mid-position and rated based on motor horsepower. Contractor to furnish fixed sheaves at final RPM as determined by balancing contractor

2.7 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint.

D. Construct coil casings of stainless steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. With two coils in the airstream, space shall be provided by the unit manufacturer to facilitate cleaning and inspection of the fin surfaces. Access door(s) shall be located in the unit casing between the two coils.

G. Dual Temperature Water Coil
   1. Heating performance shall be as specified on the unit schedule.
   2. Dual Temperature water coil fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Seamless copper tubes shall be mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
   3. Water coils shall be provided with headers of seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil connections shall be carbon steel connections with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain connections shall be furnished on the coil connection, external to the cabinet. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point.

2.8 COIL/ACCESS SECTION

A. Unit(s) shall include a separate section housing a coil section and access section as one assembly. Refer to drawings to determine which unit(s) includes the additional section.

B. Section shall include a stainless steel drainpan and an access door of sufficient size to allow for visual inspection of the leaving face of the first coil in the airstream and entering face of the second coil in the airstream shall be included as standard in this section.

C. Access door shall be of the same construction as all other doors on the unit. Refer to door specification for location of door(s).

2.9 DAMPERS

A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.

B. Damper Operators: Electric specified in Section 15900 "HVAC Instrumentation and Controls for HVAC."

C. Low-Leakage, Outside-Air Dampers: Double-skin, airfoil-blade galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed or parallel-blade arrangement with steel operating rods rotating in stainless-steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

D. Mixing Boxes: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

E. Combination Filter and Mixing Box: Parallel-blade galvanized-steel dampers mechanically fastened to steel operating rod in reinforced, galvanized-steel cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously. Cabinet support members shall hold 2-inch thick, pleated or throwaway filters. Provide hinged access panels or doors to allow removal of filters from both sides of unit.

2.10 FILTER SECTION

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

B. Provide 4” thick MERV 14 filter.

C. Filter media shall be UL 900 listed, Class I or Class II.

2.11 ELECTRIC

A. Motor shall be a premium efficiency open drip-proof type. Electrical characteristics shall be as shown on the schedule.

B. A variable frequency drive with fused disconnect switch shall be furnished and mounted by fan manufacturer for field power connection.

2.12 EXTERNAL SUPPORT KIT (INDOOR UNIT)

A. A galvanized steel support, minimum 10-gauge, shall be provided on the base of the unit. An external support kit may be used for ceiling suspension, external isolation, or housekeeping pad.

2.13 COMBINATION VARIABLE FREQUENCY DRIVES/DISCONNECTS

A. A combination variable frequency drive/disconnect package shall be factory mounted and wired by the air handling unit manufacturer. The package shall include:

1. Variable frequency drive.
2. Pulse width modulated drive with IGBT transistors.
3. LCD display and keypad.
4. English language electrical values, parameters, self-test, faults, and diagnostics.
5. Power, pending fault, and fault LED indicator lights.
6. Form C fault contacts.
7. 4-20 mA or 0-10 V speed input signal.
8. Circuit breaker disconnect.
9. Hand-Off-Auto (HOA) selector switch.
10. Current limiting NEMA Class T fuses.
11. NEMA 1 enclosure.
12. Auto restart after momentary power loss.
13. Critical frequency avoidance.
14. Power wiring in “liquid tight” conduit and junction boxes from VFD to motor.
15. Voltage and FLA shall be factory-set for exact motor used in the air handler.
16. Optional three-contactor bypass with a key operated drive-off-bypass selector switch.

2.14 AUTOMATIC TEMPERATURE CONTROLS

A. See the drawings for control schematics and sequence of operation. See the specification Section 15 "HVAC Instrumentation and Controls for HVAC." for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install air-handling units with the following vibration control devices.

1. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other mechanical 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 air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot-Water Piping: Comply with applicable requirements in Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

F. Steam and Condensate Piping: Comply with applicable requirements in Section "Steam and Condensate Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

G. Refrigerant Piping: Comply with applicable requirements in Section "Refrigerant Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

H. Duct installation and connection requirements are specified in other mechanical Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

I. Electrical: Comply with applicable requirements in Electrical Sections for power wiring, switches, and motor controls.

J. Ground equipment according to Electrical Section 16060, "Grounding and Bonding."

K. 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.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.
8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing air handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain indoor air-handling units.

B. The contractor shall provide general HVAC system training of 40 hours which shall include operating instruction, and review of wiring and control diagram showing complete layout of each system. Contractor shall engage a factory certified technician and ATC vendor to assist during training.

END OF SECTION 15725

SECTION 15763 – 4-Pipe Fan Coil Unit

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 constant-volume or variable-volume, air-handling units with fans, coils, filters, and dampers for indoor installations.

1.3 SUBMITTALS

A. Product Data: For each type of air-handling unit indicated. Include the following:

1. Certified fan-performance curves with system operating conditions indicated.
2. Certified fan-sound power ratings.
3. Certified coil-performance ratings with system operating conditions indicated.
4. Motor ratings, electrical characteristics, and motor and fan accessories.
5. Material gages and finishes.
6. Filters with performance characteristics.
7. Dampers, including housings, linkages, and operators.
8. Wiring Diagrams: Power, signal, and control wiring.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain air-handling units through one source from a single manufacturer.

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. NFPA Compliance: air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

D. ARI Certification: air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

E. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate installation with Section 15 "Vibration Isolation and Seismic Restraints."

B. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aquatherm.
2. Trane.
3. Carrier.
4. Or approved equal

2.2 MANUFACTURED UNITS

A. The air handler shall be furnished as a ceiling cassette.

2.3 General:

A. Unit shall be a factory assembled and tested water fan coil.
B. Unit shall be assembled with high quality.
C. Contained within the unit shall be all factory wiring, piping, and associated controls.

2.4 Unit Cabinet and Cover:

A. Cabinet is constructed of galvanized sheet metal.
B. Cover composed of high impact polymers.
C. Internally and externally insulated to ensure quiet operation.

2.5 Fan Motor and Blower Wheels:

A. Available in 208/230-1-50/60 VAC.
B. Fan motor shall be three speed, direct drive, and PSC type.

C. Fan motor shall be totally enclosed.
D. Fan motor shall be internal overload protected.
E. Radial blower wheel is dynamically balanced.

2.6 Air Distribution:

A. Unit contains four manually adjustable discharge air louvers.

2.7 Water Coil:

A. Manufactured with water coils containing copper tubing mechanically bonded to aluminum fins.
B. Maximum operating pressure is 150 psig.
C. Coils are designed to accept an entering water temperature not to exceed 160°F
D. Pressure independent flow control required on both coils to not exceed max flow for each coil. Consult primary coil and secondary coil data for proper sizing

2.8 Drain Pan:

A. Constructed of injected molded polystyrene.

2.9 Filters:

A. Unit shall contain a woven panel washable filter.

2.10 Fresh Air:

A. Unit shall be able to receive up to 50% filtered fresh air.
B. Fresh air introduced shall be externally fan forced and externally controlled.

2.11 EXTERNAL SUPPORT KIT (INDOOR UNIT)

A. A galvanized steel support, minimum 10-gauge, shall be provided on the base of the unit. An external support kit may be used for ceiling suspension, external isolation, or housekeeping pad.

2.12 AUTOMATIC TEMPERATURE CONTROLS

A. See the drawings for control schematics and sequence of operation. See the specification Section 15 "HVAC Instrumentation and Controls for HVAC." for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install air-handling units with the following vibration control devices.

1. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other mechanical 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 air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot-Water Piping: Comply with applicable requirements in Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

F. Steam and Condensate Piping: Comply with applicable requirements in Section "Steam and Condensate Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

G. requirements are specified in other mechanical Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

H. Electrical: Comply with applicable requirements in Electrical Sections for power wiring, switches, and motor controls.

I. Ground equipment according to Electrical Section 16060, "Grounding and Bonding."

J. 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.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill water and steam coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Final Checks before Startup: Perform the following:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Comb coil fins for parallel orientation.

8. Install clean filters.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Section "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

3.7 CLEANING

A. Clean air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

B. After completing system installation and testing, adjusting, and balancing air handling and air-distribution systems, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain indoor air-handling units.

B. The contractor shall provide general HVAC system training of 40 hours which shall include operating instruction, and review of wiring and control diagram showing complete layout of each system. Contractor shall engage a factory certified technician and ATC vendor to assist during training.

END OF SECTION 15725

SECTION 15815 - METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealants and gaskets.
8. Hangers and supports.

B. Related Sections:

1. Division 15 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 15 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 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.

1.04 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

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 bottom 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.

1.05 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, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 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 2-1, "Rectangular Duct/Transverse 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 2-2, "Rectangular Duct/Longitudinal Seams," 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 4, "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."

2.02 DOUBLE-WALL RECTANGULAR DUCTS AND 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. McGill AirFlow LLC.

2. Sheet Metal Connectors, Inc.
3. Or approved equal.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.24 Btu x in. /h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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."

2.03 SINGLE-WALL ROUND AND FLAT-OVAL 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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 3-1, "Round Duct Transverse 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."

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 3-2, "Round Duct Longitudinal Seams," 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. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.04 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND 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. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.
5. 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) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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."

    a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," 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."

    a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.24 Btu x in. /h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

2.05 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: G90
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 304 or 316; cold rolled, annealed sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the “Duct Schedule.”

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black.
6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. 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.

H. 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.

2.06 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:

    a. Type I Flexible: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    b. Type II, Rigid 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. 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. Adhesive 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. Insulation Pins and Washers:

1. 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.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick aluminum; 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 7-11, "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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. 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 or as recommended by manufacturer.
8. 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.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

2.07 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: 4 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).

11. Sealant 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."

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).
7. Sealant 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."

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.

2.08 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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. 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

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate clear inside dimension, 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. Increase sheet metal sizes to compensate for lining thickness.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval 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 15 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 "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 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.

3.03 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."

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 15 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.

3.06 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.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.08 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing. Existing duct system(s) connected to new equipment shall also be cleaned.

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 15 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.

3.09 START UP

A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing for HVAC."

3.010 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Return, exhaust and outdoor air ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.

c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

4. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Duct Steam Humidifiers:

1. Furnish and install a four-foot section of Type 316 or 304, stainless-steel sheet with No. 4 or No. 3 finish. At the humidifier location, one foot of duct shall extend against the airflow and three feet of duct shall extend with the airflow. Provide a duct access door located against the airflow of the humidifier location in order to inspect the steam jet discharging against the air stream.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

E. Liner:

1. Unless otherwise indicated all supply, Return, and exhaust air ducts shall be lined as indicated.

a. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
b. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
c. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.

2. Supply Fan Plenums: Fibrous glass, Type II 1-1/2 inches thick.
3. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II 2 inches thick.
4. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

F. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.
3. Exhaust Air Ducts: 1 inch thick.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "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 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "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: Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

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 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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 15815

SECTION 15820 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Flange connectors.
10. Turning vanes.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.
15. Duct Silencers.

B. Related Sections:

1. Division 15 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

2. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477-13 and so certified when submitted for approval. The laboratory must be currently NVLAP accredited for the ASTM E477-13 test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test

facilities will not be accepted. Shop Drawings submitted without proper certifications will be rejected.

a. Submitted silencer pressure drops shall not exceed those listed in the silencer schedule. Silencer pressure drop measurements shall be made in accordance with the ASTM E477-13 test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.

b. The manufacturer shall supply certified dynamic insertion loss and self-noise power level data for each scheduled silencer. The data shall match the project's air distribution system requirement for forward or reverse flow, and total system airflow. All ASTM E477-13 tests to obtain this data shall be conducted in the same facility and shall utilize the same silencer.

c. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.

d. Silencer generated noise shall not be greater than that listed in the silencer schedule

3. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will reduce mechanical fan noise to NC in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations. In the absence of specified background sound level criteria, the guidelines as expressed in Table 1 of Chapter 48, "Noise and Vibration Control" of the 2015 ASHRAE Handbook - HVAC Applications, shall be used.
4. The silencer manufacturer shall test the silencer(s) as indicated in the silencer schedule. The Engineer shall be notified of the test date at least two weeks in advance and the test may be witnessed by the Engineer. Test shall show compliance with the project criteria and is subject to Engineer approval. Test facilities and test reports shall be open to inspection upon request from the Engineer.
5. For specific silencers indicated on the silencer schedule, the silencer manufacturer shall provide Computational Fluid Dynamics (CFD) aerodynamic analysis. The analysis shall include the attached ductwork, a minimum of 5 equivalent duct diameters up and downstream of the silencer, as shown on the Drawings, to determine silencer pressure drop, including system effects, at design airflow. The manufacturer must report and validate a converged solution domain of the CFD analysis to show the solution is independent of mesh refinement such that two models of different mesh refinement levels produce equivalent results, each with a maximum residual tolerance of 0.001. The minimum cell count shall be 200,000 and the validation model shall have a cell count at least 50% higher. The manufacturer must report the selection of CFD parameters, including mesh type, mesh size, boundary conditions, convergence criteria, and turbulence model. Each CFD analysis shall also include additional post-processed information including number of iterations, convergence status, and resulting y+ values.

B. 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. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    e. Duct security bars.
    f. Wiring Diagrams: For power, signal, and control wiring.

C. 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.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 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.

1.05 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

    1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.01 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. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inchesor less; 3/8-inchminimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Duro Dyne Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.
6. SEMCO Incorporated.
7. 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-hick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inchwidth.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.
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 Mounting: Rear mounted.
7. Screen Material: Aluminum.
8. Screen Type: Bird.
9. 90-degree stops.

2.03 BAROMETRIC RELIEF DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Duro Dyne Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.
6. SEMCO Incorporated.
7. Or approved equal.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: 0.064-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades:

1. Multiple, 0.025-inch-thick, roll-formed aluminum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Neoprene.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Aluminum.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Stainless steel.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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. Air Balance Inc.; a division of Mestek, Inc.
b. Flexmaster U.S.A., Inc.
c. McGill AirFlow LLC.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Pottorff; a division of PCI Industries, Inc.
g. Ruskin Company.
h. Or approved equal.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Hat-shaped, galvanized-steel channels, 0.064-inchminimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Stiffen damper blades for stability.
c. Galvanized-steel, 0.064 inchthick.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Molded synthetic.

b. Dampers in ducts with pressure classes of 3-inch wgor less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

2.05 CONTROL DAMPERS

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. Arrow United Industries; a division of Mestek, Inc.
2. Duro Dyne Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. Ruskin Company.
9. Young Regulator Company.
10. Or approved equal.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed-blade design.
3. Stainless steel.
4. 0.064 inchthick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Molded synthetic.

2. 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.
3. Thrust bearings at each end of every blade.

2.06 FIRE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Ruskin Company.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
5. Or approved equal.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpmvelocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside 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: 0.052 or 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. Heat-Responsive Device: Replaceable, 165 deg Frated, fusible links.

2.07 SEVERE ENVIRONMENT DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Ruskin Company.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
5. Or approved equal.

B. Severe environment dampers shall be made of type 316 stainless steel and shall be corrosion-resistant. The heat responsive devices (for fire and/or smoke dampers) shall be UL compliant.

C. Applications include high humidity and mildly corrosive airstreams (swimming pools, laboratories, waste water treatment plants, food processing plants, and coastal/maritime buildings).

2.08 SMOKE DAMPERS

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. Ruskin Company.
2. Greenheck Fan Corporation.
3. Air Balance Inc.; a division of Mestek, Inc.
4. Or approved equal.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

E. Blades: Roll-formed, horizontal, overlapping, 0.063-inch-thick, galvanized sheet steel.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Modulating action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or

adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling fan control or position indication.
2. Test and reset switches, remote mounted.

2.09 COMBINATION FIRE AND SMOKE DAMPERS

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. Ruskin Company.
2. Greenheck Fan Corporation.
3. Air Balance Inc.; a division of Mestek, Inc.
4. Or approved equal.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: Modulating action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Direct Digital Control (DDC) System for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

O. Accessories:

1. Auxiliary switches for signaling fan control or position indication.
2. Test and reset switches, remote mounted.

2.010 FLANGE CONNECTORS

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. 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.

2.011 TURNING VANES

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
6. 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 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.012 DUCT-MOUNTED ACCESS DOORS

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. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.
5. Ventfabrics, Inc.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
7. Or approved equal.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - 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.

2.013 DUCT ACCESS PANEL ASSEMBLIES

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. 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 0.0528-inch steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.014 DUCT SILENCERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Vibro-Acoustics.
2. McGill AirFlow LLC.
3. Ruskin Company.
4. Pottorff.
5. Or approved equal.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inchthick18 gauge. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 48" shall have at least two half splitters and one full splitter.

E. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.

1. Rectangular Silencers: 26 gauge.

2. Rectangular Elbow Silencers: 22 gauge.

3. Circular Silencers:

a. Connection diameter up to 18 inches: 26 gauge.

b. Connection diameter greater than 18 inches: 22 gauge.

4. Transitional Silencers: 22 gauge.

F. Special Construction: Suitable for outdoor use.

G. Connection Sizes: Match connecting ductwork unless otherwise indicated.

H. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative type with fill material.

a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression Moisture-proof nonfibrous material.
b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

3. Lining: Mylar.

I. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Flange connections.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

J. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.
2. Removable splitters.

K. Capacities and Characteristics: See Plan Schedules.

2.015 FLEXIBLE CONNECTORS

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. 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 5-3/4 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.

2.016 FLEXIBLE DUCTS

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. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or approved equal.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wgpositive and 1.0-inch wgnegative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wgpositive and 1.0-inch wgnegative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Minimum R-6.

2.017 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

3.01 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 fire and smoke dampers according to UL listing.

H. 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 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. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. 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.

K. Label access doors according to Division 15 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wgand more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts with maximum 6-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 72-inchlengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with liquid adhesive plus tape and draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 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. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 15820

SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Adjustable bar registers and grilles.
4. Fixed face grilles.

B. Related Sections:

1. Division 15 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 15 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 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.
3. Sound ratings: Provide sound data measurements/ratings measured at same distance as basis of design specified equipment.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. 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.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Nailor Industries Inc.
    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, color selected by Architect.
5. Face Size: 24 by 24 inches or 12 by 12 inches.
6. Face Style: Three cone, Four cone, or Plaque.
7. Mounting: Surface, T-bar, or Mounting panel.
8. Pattern: Fixed or Adjustable.
9. Dampers: Combination damper and grid.
10. Accessories:

    a. Equalizing grid.
    b. Plaster ring.

B. Louver Face Diffuser:

1. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Nailor Industries Inc.
    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, color selected by Architect.
5. Mounting: Surface, T-bar, or Mounting panel.
6. Pattern: One-way, Four-way, or Adjustable core style.
7. Dampers: Combination damper and grid.
8. Accessories:

    a. Square to round neck adaptor.
    b. Adjustable pattern vanes.
    c. Equalizing grid.
    d. Plaster ring.

2.02 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Nailor Industries Inc.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw or Lay in.
9. Damper Type: Adjustable opposed blade.
10. Accessories:

    a. Front or Rear-blade gang operator.

B. Adjustable Bar Grille:

1. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Nailor Industries Inc.
    b. Price Industries.
    c. Titus.
    d. Or approved equal.

2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal 3/4 inch apart.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw or Lay in.

2.03 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."

B. Sound Ratings shall be equal or better than basis of design. Any sound rating deviation shall be approved by Owner.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855

SECTION 15860 - LOUVERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Fixed, extruded-aluminum louvers.

1.03 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.

1. Wind Loads: Determine loads based on a uniform pressure of 30-lbf/sq. ft., acting inward or outward.

B. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. 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, ambient; 180 deg F, material surfaces.

C. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing

manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Airborne Sound Transmission Loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width according to ASTM E 90.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.

1. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Wiring Diagrams: Power, signal, and control wiring for motorized adjustable louvers.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Louvers:

a. Arrow United Industries.
b. Carnes Company, Inc.
c. Construction Specialties, Inc.
d. Greenheck.
e. Ruskin Company; Tomkins PLC.
f. Safe Air/Dowco.
g. United Enertech.
h. Or approved equal

2.02 MATERIALS

A. Aluminium Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat-head or hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel or Exterior flange or Interior flange, unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
4. Exterior Corners: Prefabricated corner units with mitered and welded blades or mitered blades with concealed close-fitting splices and with fully recessed or semirecessed mullions at corners.

F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.04 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Louver Depth: 4 inches or 6 inches as scheduled on the drawings.
2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch for blades and 0.080 inch for frames.
3. Mullion Type: Exposed.
4. Performance Requirements:

    a. Free Area: Not less than 8.0 sq. ft. for 48-inch wide by 48-inch high louver.
    b. Point of Beginning Water Penetration: Not less than 1000 fpm.
    c. Air Performance: Not more than 0.10-inch wg static pressure drop at 750-fpm free-area velocity.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.05 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screen Location for Adjustable Louvers: Interior face, unless otherwise indicated.
3. Screening Type: Bird screening.

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch square mesh, 0.063-inch wire.

2.06 BLANK-OFF PANELS

A. Insulated, Blank-off Panels: Laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets.

1. Thickness: 1 inch or 2 inches as indicated on the drawings.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Unfaced mineral-fiber rigid insulation board.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with 1/8-by-l-inch PVC compression gaskets.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels to back of louver frames with clips or stainless-steel, sheet metal screws.

2.07 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.08 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes. Architect to select finish below:

1. Fluoropolymer Three-Coat Coating System: Manufacturer's standard three-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; complying with AAMA 2605.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.04 CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 15860

SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes a complete web-based, interoperable Building Management System (BMS) based on server/thin client architecture. In addition to other capabilities described hereinafter, the BMS shall include full programmability of all connected nodes (controllers) via the web for an authorized user. The BMS shall also include override capability of all controller outputs via the web for an authorized user. An authorized user shall also be able to create/ edit graphic screens, trends and alarms on-site using the specified hardware and software.

B. The BMS system shall interface seamlessly with the existing Honeywell Niagara 4 Platform Building Solutions automation system which currently serving the Princeton Public Schools facilities. All new controllers shall interface with the School's existing Network Control Panel and accessed through the District's existing BAS workstation.

C. This Section includes a complete web-based, interoperable Building Management System (BMS). In addition to other capabilities described hereinafter, the BMS shall include full programmability of all connected nodes (controllers) via the web for an authorized user. The BMS shall also include override capability of all controller outputs via the web for an authorized user. An authorized user shall also be able to create/ edit graphic screens, trends and alarms on-site using the specified hardware and software.

D. Network level components of the system – workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004. No gateways shall be used for communication to controllers furnished under this section.

E. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the Specification and provide for a complete and operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

F. The BMS Contractor shall coordinate with HVAC equipment & system manufacturers for factory installation of their controllers & devices to assure seamless system operation.

G. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS system supplier and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS system supplier shall demonstrate the operation of the system and prove that it complies with the intent of the Drawings and Specifications.

H. Provide services and manpower necessary for commissioning of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.

I. All Work performed under this section of the Specifications will comply with all governing codes, laws and governing bodies. If the Drawings and/or Specifications are in conflict with governing codes, the Contractor, with guidance from the Engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this Specification and associated Drawings exceed governing code requirements, the Specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

J. Related Sections include the following:

1. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units. Depending on the scope of the project, the complete Specification may have numerous sections that interface to this section, including several from Division 25, 16, & 28.

2. Section 15940 - Sequence of Operation.
3. Section 15058 - Common Motor Requirements for HVAC Equipment.
4. Section 15950 - Testing, Adjusting, and Balancing for HVAC
5. Section 16051 - Common Work Results for Electrical.
6. Section 16120 - Low Voltage Electrical Power Conductors & Cables.
7. Section 16140 - Wiring Devices.

1.03 DEFINITIONS

A. Standard

1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers.
2. AHU: Air Handling Unit.
3. BACnet: Building Automation Controls Network.
4. BMS: Building Management System.
5. DDC: Direct Digital Control.
6. EIA: Electronic Industries Alliance.
7. GUI: Graphical User Interface.
8. HVAC: Heating, Ventilation, and Air Conditioning.
9. EEE: Institute Electrical Electronic Engineers.
10. VAV: Variable Air Volume Box.

B. Communications and Protocols

1. ARP: Address Resolution Protocol.
2. CORBA: Common Object Request Broker Architecture.
3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect.
4. DDE: Dynamic Data Exchange.
5. FTT: Free Topology Transceivers.
6. HRDB: Hierarchical Real-Time Database.
7. HTTP: Hyper Text Transfer Protocol.
8. LAN: Local Area Network.
9. MS/TP: Master Slave Token Passing.
10. ODBC: Open Database Connectivity.
11. SNVT: Standard Network Variable Types.
12. SQL: Structured Query Language.
13. XML: exTensible Markup Language.

C. Controllers

1. ASC: Application Specific Controller.
2. ASD: Application Specific Device.
3. CAC: Custom Application Controller.
4. LNC: LON Network Controller.
5. ENC: Enterprise Network Controller.
6. VAVDC: Variable Air Volume Digital Controller.

D. Tools and Software

1. PES: Portable Engineering Station

1.04 SYSTEM DESCRIPTION

A. OVERVIEW: This section contains the design intent and functionality of the BMS. The BMSC shall provide an direct extension of the existing Honeywell Niagara 4 Platform based Building Management System Utilizing Direct Digital Control (DDC), for the heating and cooling air conditioning systems and shall interface with other building microprocessor based subsystems as shown on the project documents, point lists, drawings and as described in these specifications. This scope of work shall include a complete working system including all engineering, programming, controls and installation materials, installation labor, commissioning and start-up, training, final project documentation and warranty.

B. It is the intent of this contract to provide the Princeton School District with an integrated and updated DDC control system utilizing the existing District Wide existing Honeywell Niagara 4 Platform based Building Management System and providing new DDC controls that are ANSI/ASHRAE Standard 195-2004 BACnet compliant for this project. Contractor shall update all graphics on operator terminals and web interface to provide full integration with owner's

existing Honeywell Niagara 4 Platform based Building Management System. New graphics shall match existing to provide a seamless interface and appearance.

C. PROJECT DRAWINGS AND SPECIFICATIONS: The work of the single BMSC shall be as defined individually and collectively in all Sections of this Division's specifications together with the associated project drawings and the associated interfacing work as referenced in the related documents. The project BMS diagrams and drawings are diagrammatic only and shall not be utilized for installation configuration or mounting.

D. BMS DESIGN SCOPE INTENT: The intent of this specification Section is to provide the following features, functionality, and interface services:

E. SCOPE OF WORK: Furnish all labor, materials, and equipment necessary for a complete and operating extension of the existing Honeywell Building Management System, utilizing Niagara 4 Direct Digital Controls as shown on the drawings and as described herein. The projects control diagrams and drawings are diagrammatic only and are provided to show overall design intent. All DDC controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, Modbus). The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara4 Framework.

F. BMS SUPERVISORY NETWORK CONTROLLER OPEN PROTOCOLS: The BMS architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and Modbus. An Open System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner's LAN. Each Supervisory Network Controller and DDC controller shall be peer-to-peer BACnet™ Open Systems protocol communication and shall communicate via the district's Wide Area Network (WAN) using BACnet™ open protocol.

G. UNIT MANUFACTURER (UM) EQUIPMENT: Fully integrate the UM DDC equipment into the BMS via a communications interface. Provide hardware, software, and wiring to provide communication interfaces.

H. OCCUPIED SPACES: All work in occupied spaces or which adversely affect occupants shall be performed during coordinated with the Facilities Department to occur during unoccupied times, or after-hours at no additional cost.

I. EMBEDDED PROGRAMMING TOOLSET: All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.

J. INSTALLATION: The Building Management System shall be complete in all respects including labor, materials, equipment, and services necessary, and shall be installed by personnel regularly employed by the Building Management System Contractor (BMSC) . The Building Management System Contractor shall utilize Union electrician labor for all the system installation.

K. GRAPHICS: All graphics and navigation schemes for this project shall meet the standard of the Honeywell Niagara4 Framework server. Include all extension of software licensures and software maintenance which is required to modify the existing BMS programs and graphics.

L. FULL CLEARENCE AND SYSTEM ACCESS: The Owner shall receive Administrator level login and passwords for at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS. All of the BMS I/O points along with their associated control parameters, calculations and variables shall be accessible via any Web Browser through a secured connection to the BMS.

M. OPEN SOURCE: The BMS shall Open Source, consisting of materials and components which are available through Open Source product procurement suppliers. Single source exclusivity or other conditions which inhibit the Owner from obtaining both materials and support services from less than three independent procurement avenues of shall not be acceptable. The BMSC shall at the request of the A-E provide the Open Source names, addresses and contact information of at three (3) additional independent sources of acquiring the BMS products.

N. NIAGARA OPEN SYSTEM PLATFORM (BACnet): Only a BMS that utilizes the Niagara 4 Framework shall satisfy the requirements of this section. Any BMSC that requires additional server software shall be unacceptable. The BMSC shall furnish and install a complete Honeywell Niagara N4 Frameworks BMS including all necessary hardware, all operating and applications software necessary to perform the control sequences as called for in Section 15 “Sequence of Operation for HVAC Equipment”, BMS Diagrammatic Details, as shown on the project drawings. The new DDC controllers furnished in this section shall be an Open System platform. All programming of the shall utilize the Open Niagara N4 Platform embedded software package and communicate peer-to-peer via the Open ASHRAE 135 BACnet communications protocol.

O. NIAGARA INTERFACE CONFORMANCE STATEMENTS (NICS): All NICS shall follow the Open Niagara Interface Conformance specifications. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted “safe boot” technology. To ensure quality, any additional JACE hardware products used on this project shall come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting these requirements shall not be allowed.

P. PEER TO PEER COMMUNICATIONS: The BMS architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum BACnet MS/TP, BACnet IP, LonTalk, N2 and MODBUS RTU.

Q. WEB-BASED GRAPHICAL USER INTERFACE: The Operator shall be able manage the BMS through a connected web-browser software without additional applets or software required from an open web-browser. The BMSC shall provide 3-Dimensional web-based color and

animated graphics. The graphics shall include floor plans showing the location of the controlled equipment and links to the individual equipment graphics. Copies of the web graphics shall be retained in the BMS Archival Data Server.

R. LOCAL AND REMOTE CONNECTIVITY: The BMS shall provide the Owner with a secure remote and local access shall be through an internal TCP/IP network connection. Alarm notification to designated stations and personnel through the TCP/IP network connection.

S. INFORMATION TECHNOLOGY (IT) COMPLIANCE: The BMS shall be designed for use with the Owner's current enterprise level IT system. The BMS TCP/IP devices located in IT rooms shall be fully IT compatible devices that communicate directly on the IT infrastructure in the facility.

T. BUILDING LEVEL DDC CONTROLLERS (B-BC): Building Level Controllers (B-BC) shall be provided for HVAC equipment and shall be networked together using CAT-6 Ethernet cable. Provide 1 Gigabit communication between BMS servers and clients. Provide 100 Megabit Peer-to-Peer communications among B-BC responsible for HVAC equipment Control. B-BC controllers shall be utilized on the Central Plant Systems (e.g., Chilled Water Systems, Heating Systems, etc.…).

U. ADVANCED APPLICATION CONTROLLERS (B-AAC): B-AAC Controllers shall communicate across a floor level MS/TP communications network. Application of the B-AAC shall be required where the standard sequence of operation is outside the capability of a B-ASC. A B-AAC shall not be utilized on Central Plant Systems.

V. APPLICATION SPECIFIC CONTROLLERS (B-ASC): B-ASC Controllers shall communicate across a floor level MS/TP communications network. Typical applications include Fan Coil Units, Heat Pump Units, Unit Ventilators, Constant and/or Variable Air Volume Boxes and Exhaust Fans. A B-ASC shall not be utilized on Central Plant Systems.

W. BUILDING MANAGEMENT SYSTEM DESIGN: The BMS design shall be by the BMSC's in-house engineers.

X. STANDARD COMPONENTS: All material and equipment shall be standard components, regularly manufactured for this and/or other systems and not custom designed specifically for this project. All devices and components shall have been thoroughly tested and proven in actual use for at least two years prior to this project.

Y. SCALABILITY: The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, and operator interface devices.

Z. SINGLE FAULT INDEPENDENCE: The network riser architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming, and trending function, or any function at any operator interface device.

AA. PEER-TO-PEER: DDC Controllers shall be able to access any data from, or send to control commands and alarm reports to, any other DDC Controller or combination of DDC controllers on the network without dependence upon a central or intermediate processing device.

BB. ALARMS: DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device.

CC. SECURITY: DDC Controllers shall be able to assign password access and control priorities to each point individually. The Logon password shall enable the operator to monitor, adjust or control only the points that the operator is authorized. All other points shall not be displayed at the PC workstation or portable terminal. Passwords and priority levels for every point shall be fully programmable and adjustable.

DD. SPARE CAPACITY: All DDC controllers shall be installed with 20% spare I/O points of each type (minimum 1) and a 50% spare memory capacity.

EE. BUILDING MANAGEMENT SYSTEM CONTRACTOR (BMSC)'S RESPONSIBILITY:

1. The Building Management System Contractor (BMSC)) shall only use in house employees who are skilled, experienced, factory trained, and familiar with the specific equipment, software, standards, and configurations to be provided for this Project.
2. The BMSC shall provide a complete, neat, and workmanlike installation using only directly employed who are skilled, experienced, trained, and familiar with the specific equipment, software, standards, and configurations to be provided for this Project.
3. The BMSC shall manage and coordinate the BMS work in a timely manner in consideration of the Project schedules and shall coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
4. The BMSC shall provision all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in this section which are required for the complete, fully functional BMS.

FF. AGENCY APPROVALS: The BMS shall be provided with the following agency approvals. Products not currently offering the above approvals are not acceptable. Verification that the approvals exist for all submitted products shall be provided on request.

1. Federal Communications Commission (FCC) Rules and Regulations, Vol II – 1986 Part 15 Class A, Subpart B, Class B, Subpart C, Subpart J, Class A

2. Underwriter Laboratories (UL): UL 916 - Energy Management Systems All.

3. Institute of Electrical and Electronic Engineers (IEEE) C62.41

4. National Electrical Manufacturers Associations NEMA 250 - Enclosures.

1.05 COORDINATION AND WORK RESPONSIBILITY AND MATRIX

A. TRADE RESPONSIBILITIES MATRIX: The demarcation of work and responsibilities between the BMSC and other related trades shall be as outlined in the "Coordination and Work Responsibility Matrix" below:

Coordination and Work Responsibility Matrix Work Description	Furnish	Install	Low Voltage Wiring	Line or Power Wiring
BMS N4 DDC Controllers	BMSC	BMSC	BMSC	-
BMS control wiring	BMSC	BMSC	BMSC	BMSC
BMS power wiring	BMSC	BMSC	BMSC	16
BMS communications wiring	BMSC	BMSC	BMSC	-
BMS enclosures	BMSC	BMSC	BMSC	16
BMS conduits and raceway	BMSC	BMSC	-	-
Equipment Interface	UM	BMSC	BMSC	-
Roof Top Unit controls	BMSC	BMSC	BMSC	16
HVAC Unit controls	BMSC	BMSC	BMSC	16
Unit Ventilator control	BMSC	BMSC	BMSC	16
AC Unit Controls	UM	BMSC	BMSC	16
Remote Condenser Unit wiring	BMSC	BMSC	BMSC	16
Convector controls	BMSC	UM	BMSC	16
Control Panels (Wall)	BMSC	BMSC	BMSC	16*
Control Dampers – External to units	15	SM	-	-
Control Dampers Actuators	15	BMSC	BMSC	-
Pipe insertion devices and taps	BMSC	15	-	-
Concrete equipment pads	15	15	-	-
Seismic bracing	15	15	-	-
Control Valves and Actuator	15*	15	BMSC	-
Manual Valves	15	15	-	-
Variable Frequency Drives - HVAC	15	16	BMSC	16
Motor Starters	15	16	BMSC	16
*Reference Equipment Unit Schedule and specification, BMS Diagrams and Specification Section 15. Responsibility or work is additionally specified under separate subsections.				
DIV15	Division 15 Mechanical Contractor			
DIV16	Division 16 Electrical Contractor			
BMSC	Division 15 Building Management System Contractor			
SMC	Division 15 Sheet Metal Contractor			
UM	Equipment Unit Manufacturer			

B. BMSC ELECTRICAL WORK: The BMSC shall provide electrical work as required in the specification, including:

1. Installation of all control wiring by a New Jersey licensed Electrical Contractor.
2. All BMS electrical work, except as otherwise specified, or shown on the Division 16 Electrical specifications or drawings.
3. Installation of control wiring may include line voltage and low voltage wiring, as required.
4. Power wiring (120VAC) for the BMS, including control panels, DDC controllers, actuators, and sensors from a designated circuit furnished by the Division 16 Electrical Contractor.
5. All control wiring in mechanical equipment spaces shall be installed in EMT. The conduit for power systems may be used for running control line voltage wiring. Low voltage plenum rated wiring can be run exposed above accessible ceiling and shall be supported per code and not laid on ceiling tile grid.
6. Low voltage wiring shall be concealed in finished rooms. If any wiring must be exposed in rooms, it shall be installed in wiremold raceway.
7. A monitoring point from the smoke detectors to the DDC controller for status. Where multiple detectors are provided, one signal shall be provided.
8. All safety devices wiring through the Hand and Auto positions of motor starting devices.

C. DIVISION 16 ELECTRICAL WORK (DIV16): The Division 16 Electrical Contractor Work shall be responsible for all interlock and wiring on the Division 16 Electrical specifications or drawings. The Division 16 Electrical Contractor shall coordination with the BMSC for any required field control panel circuit feeds. The Division 16 Electrical Contractor, as part of its contract, shall provide 1P-20A circuit breakers. The Division 16 Electrical Contractor shall also provide power wiring to motors, heat trace, junction boxes for power to BMS panels and all work related to smoke detectors, smoke dampers, and the fire alarm system.

D. DIVISION 15 MECHANICAL WORK (DIV15) The Division 15 Mechanical Contractor (MC) shall be responsible for the Installation of automatic control valves, threadolet, thermowells, flow meters/switches, pressure sensor taps and associated shut-off/bypass cocks, or any other devices required in the piping. Any Motor starters furnished by the Mechanical Contractor shall have control transformers and one set of auxiliary contacts, as required for interlocks.

E. DIVISION 15 SHEET METAL (SMC): The Division 15 Sheet Metal Contractor shall be responsible for providing and installing of automatic control dampers, external to the equipment, smoke dampers, duct smoke detectors and access doors as required. The Division 15 Sheet Metal Contractor shall also install any duct airflow measuring stations or other devices required to be installed into the ductwork and as otherwise determined by tradeline jurisdictions.

1.06 PROJECT SITE CONDITIONS:

A. COOPERATION WITH OTHER TRADES: Coordinate the Work of this section with that of other sections to ensure that the Work shall be carried out in an orderly fashion. It shall be the BMSC's responsibility to check the Project and Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct, and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features. The BMSC shall repair any damage caused by his work to the building(s) and equipment at no additional cost to the owner.

B. PROJECT SEQUENCING: Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

C. COMPONENT INSTALLATION: Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

D. POWER SOURCE: Coordinate the supply of conditioned electrical branch circuits for control units and operator workstation with the Division 16 Electrical contractor. Coordinate equipment with the appropriate Divisions of the Electrical Specifications for Power, Wiring, Conduit, Fire Alarm, Motor Control Centers, etc. to achieve compliance, compatibility, and interfaces.

E. THIRD PARTY BMS INTEGRATION: Coordinate equipment with the appropriate Divisions of the Mechanical Specifications for Motor Controllers, Manufacturer Supplied Controls, etc. to achieve compliance, compatibility, and interfaces.

F. CHANGES IN SCOPE OF WORK: Any changes in the scope of work must be authorized by a written Change Order, and issued by the customer, in accordance with Contract conditions.

G. CORRECTION OF WORK: The BMSC shall promptly correct all BMS work found to be defective or failing to conform to the Contract Documents at no additional cost.

1.07 PERFORMANCE STANDARDS

A. STANDARD MATERIAL/PRODUCTS: All material and equipment used shall be standard components, regularly manufactured and available, and not custom designed especially for this project

B. MODULAR DESIGN: The system architecture shall be fully modular permitting expansion of application software, system peripherals, and field hardware.

C. PERFORMANCE: The system, upon completion of the installation and prior to acceptance of the project, shall perform all operating functions as detailed in this specification.

D. SINGLE SYSTEM ARCHITECTURE: The BMS shall be consistent with BMS system throughout the owner's facilities running the Niagara 4 Framework. The BMS shall fully integrate the unit manufacturer HVAC controls systems into a new Open Source - Open System Niagara Frameworks BMS. The BMS shall fully integrate any remaining legacy DDC controls systems into a new Open Source - Open System Niagara Frameworks BMS. All BMS DDC controllers shall be available through avenues for procurement and from multiple sources (Open Source).

E. OPEN SYSTEM: OPEN PROTOCOL BMS COMMUNICATIONS: The entire BMS shall be in compliance with the ANSI/ASHRAE 135 BACnet standard. BACnet protocols and LAN types shall be used throughout and exclusively. Non-BACnet compliant or propriety equipment or systems (including gateways) shall not be acceptable and are specifically prohibited. As part of BMS submittal package the BMSC shall provide Product Information Conformance (PIC) statement for each Niagara N4 DDC Controller, indicating the DDC controller’s Niagara and BTL conformity to ASHRAE BACnet standard. The BMS shall conform to the industry network standards utilizing TCP/IP connections. The Building Management System product-lines, which are based on a proprietary operating system, utilizing proprietary networks, baud-rates or variants which cannot be extended by third party DDC System manufacturers, will not be acceptable. (i.e., BACnet over ARCnet 156K)

F. OPEN SOURCE: WEB BASED DIRECT DIGITAL CONTROLS: The BMS shall consist of Open Source BACnet Direct Digital Controllers (DDC). All of the BACnet DDC controllers shall be integrated into a distributed network system communicating over a single communications network. All web graphics shall be generated for interface with a standard web browser. The Operator shall interface with the BMS from any standard browser over a TCP/IP connection, including over the Internet. All programming and system software shall be licensed to the Owner with full password capability and access. Under no circumstances shall any part of the BMS or software be licensed or controlled by the BMSC. Upon completion of the project, the BMSC shall provide to the Owner the entire programming software including original installation discs.

G. WEB BASED 3-DIMENSIONAL COLOR GRAPHICS: The BMS shall be tested using manufacturer's recommended hardware and software for Operator Workstation (Web Server and web browser). All Web Based Graphics shall be generated on the workstation for use over the Web. The web browser shall depict the equipment’s animated graphics, scheduler graphics, alarm screens, point and click setpoint adjustments, point and click alarm acknowledgements and resets and other graphics displays required by Operator. The BMS System architecture shall provide secure Web access using any of the current versions of web browsers from any computer on the Owner's LAN. The BMS connected equipment to be monitored, controlled, and scheduled from web client computers onsite and remote sites. The units shall be dynamically depicted in 3 dimension aspect, with animated components in real time. All BMS interface points shall be on standard PC web browsers that do not require any special software from the BMS manufacturer for use as a GUI.

H. WEB GRAPHIC DISPLAY: The Graphics screens may have up to 20 dynamic points with current data, display this data within 10 seconds. The Graphic screens shall automatically refresh every 15 seconds.

I. PROGRAM EXECUTION FREQUENCY: The DDC controllers shall be able to completely execute PID loops at a frequency down to once per second, consistent with the mechanical process under control.

J. RESPONSE TIMES:

1. OBJECT SCANNING: Transmit change of values to requesting device within six seconds.
2. OBJECT COMMAND: Device response of less than two seconds after command.
3. ALARM RESPONSE TIME. Annunciation at the workstation within 15 seconds.

4. RESTORATION OF POWER: Restart of DDC controllers within 180 seconds.
5. CONFIGURATION AND TUNING SCREENS: Automatically refresh within 6 seconds.

K. REPORTING ACCURACY OF CONTROL: Report values and maintain measured variables within tolerances as follows:

TABLE 1: Reporting Accuracy	
Measured Variable	Reported Accuracy
Space Temperature	plus, or minus 1 degree F
Ducted Air Temperature	plus, or minus 1 degree F
Outside Air Temperature	plus, or minus 2 degree F
Dew Point Temperature	plus, or minus 3 degree F
Water Temperature	plus, or minus 1 degree F
Relative Humidity	plus, or minus 5 percent
Air Pressure (ducts)	plus, or minus 0.1 in. w.c.
Carbon Dioxide (CO2)	plus, or minus 50 ppm

1.08 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.

A. Section 15820 – Ductwork Accessories:

1. Automatic Dampers.
2. Airflow Stations.
3. Terminal Unit Controls.

1.09 SUBMITTALS

A. INDEX OF SUBMITTALS: Submit under provisions of Section 01 33 23 Shop Drawings, Product Data, and Samples. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and

item description. The submittal packages shall be as approved and reviewed by the Architect and Engineer (A-E) for contract compliance.

1. Contractor Qualification Submittal
2. BMS Software and Hardware Submittals
3. Graphics Submittal
4. Operation & Maintenance Manual Submittal

B. SUBMISSION: Submittals shall be in defined packages. Each submittal package shall be complete and shall only reference itself and previously submitted packages. Provide drawings as AutoCAD compatible files on optical disk (file format: .dwg, .dxf, .vsd, or comparable) or hard copies on 11" x 17" prints of each drawing.

C. SUBMISSION PERIOD: The BMSC shall submit a list of projected dates of required submittals within thirty (30) days of contract award.

D. SUBMITTAL QUANTITY: The BMSC shall submit Electronic copies (PDF) of shop drawings of the entire control system shall be submitted with two (2) hardcopies of each submittal type submitted for review prior to ordering or fabrication of the equipment.

E. DEVIATIONS: Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

F. SUBMITTAL REVIEW PERIOD: Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS design work.

G. SUBMITTAL APPROVAL: Submittals shall be approved before any equipment is installed. Begin no work until submittals have been approved for conformity with design intent.

H. CORRECTION – RESUBMISSION: The BMSC shall correct any errors or omissions noted in the first A-E review, and provide a resubmission for approval, showing corrections prior to installation. Any further subsequent resubmissions for errors or corrections previously noted shall be at the expense of the BMSC.

I. CONTRACTOR QUALIFICATION SUBMITTAL: Submit documentation of BMS Manufacturers and BMSC's qualifications, including those indicated in this Section's "Quality Assurance" if so, requested by the A-E.

J. ACTION SUBMITTALS: When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements.

K. CONTROL DIAGRAMS: BMS network architecture diagrams: Riser diagrams showing network switch locations, network topology including control network layout, communication protocol, and wire types. Showing including all nodes and interconnections. Schematic diagrams of all control, communication, and power wiring for central system installation. Show interface wiring to control system.

L. SEQUENCE OF OPERATIONS: Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system.

M. SYSTEMS SCHEMATICS: 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.

N. BMS LEGEND: Provide a list of BMS point naming convention. Indicate the format, structure, and standards of typical point names. Each Field Tag shall be 6-10 characters in length and incorporate industry standard designations. The project plan designation of the equipment &/or room will be utilized. The naming convention shall follow the "BUILDING.FLOOR.ROOM.EQUIPMENT.POINT" format. Such that the specific point for the Supply Air Temperature on AHU 1 on the 3rd floor of Building A3 would be addressed as A3.FLR03.AHU01.SAT. Where a VAV in Room C313 would to be named "FLR3.AHU04.VAV.C313:Room Temp"

O. POINT SCHEDULES: Points schedule for each point in the ATC, including Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address. Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.

P. USER INTERFACE GRAPHICS: Provide samples of the graphic display screen types and associated menus. Provide a sample graphic of each controlled system with labeled control points and graphically show locations of control elements. Provide floor plan schematic diagrams indicating control panel and space temperature sensor locations. Provide the sample

color graphics on 11 x 17” prints for each typical system indicating conceptual layout of pictures and data for each graphic. List of color graphics to be provided showing or explaining which other graphics can be directly accessed.

Q. BILL OF MATERIALS: Provide a complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used. Show the manufacturer’s description, technical data such as product specifications for relevant items furnished under this contract. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

R. PRODUCT DATA SHEETS: Provide data sheets or marked catalog pages including part number, photo and description for all products including software. Show manufacturer’s description and technical data, such as product specification sheets, installation, and maintenance instructions for items. Provide construction details, material descriptions, dimensions of individual components and profiles, and finishes. Provide Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity. Show Product description with complete technical data, performance curves, product specification sheets, installation, operation, and maintenance instructions including factors effecting performance.

S. MULTIPLE SUBMISSIONS: If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission. Clearly identify each submittal requirement indicated and in which submission the information shall be provided. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

T. GRAPHICS SUBMITTAL: Provide graphical samples of standard and custom 3 dimensional, high Definition color Web Based graphic screens for floor plans of the building(s) and all mechanical

system(s). For each Web screen, provide a conceptual layout of the equipment along with monitoring and control parameters if so, requested by the A-E.

U. HARDWARE SUBMITTAL: Shop Drawings shall include and consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed and electronic format. Examples of written Unit Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval. Shop Drawings shall include the following requirements:

1. Prepare an index sheet of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
2. Prepare all shop drawings in the latest version of AutoCAD Software. The BMSC shall furnish an electronic copy with the submittal.
3. The BMS Riser Diagrams shall depict the locations of all controllers and workstations, with associated network wiring.
4. System Schematics of each mechanical system shall show all connected input/output control points, controllers, power supplies, system diagram, end device details, termination points and wire and type required from control panel to end device with reference to their associated controller.
    a. Typical drawings shall be allowed where appropriate.
5. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and shall properly function as a system.
6. Shop drawings shall Specific Terminal identification for all control wiring shall be shown on the shop drawings (i.e., point to point diagram).

V. PRODUCT DATA: Manufacturer's data sheets on each product to be used. Data shall contain manufacturer's data on all hardware and software products required by the specification including:

1. NICs for each BMS controller
2. PICs for each BACnet controller
3. Preparation instructions and recommendations.
4. Storage and handling requirements and recommendations.

5. Installation methods.
6. Product Certificates: Compliance with Article, Quality Assurance.

W. AUTOMATIC CONTROL VALVE SCHEDULES:

1. Indicate control valve size
2. Indicate flow pattern
3. Indicate control valve connections and ratings
4. Indicate control flow rate
5. Indicate control valve pressure drop
6. Indicate control valve CV rating
7. Indicate control body material
8. Indicate control valve temperature and pressure rating
9. Indicate control valve location
10. Indicate control valve tagging
11. Indicate Leakage flow at maximum system pressure differential.
12. Indicate Torque required at worst case condition for sizing actuator.
13. Indicate actuator selection indicating torque provided.
14. Indicate Maximum close-off pressure.
15. Indicate actuator signal to control valve (on, close or modulate).
16. Indicate actuator position on loss of power.
17. Indicate actuator position on loss of control signal.
18. Indicate control valve actuator power requirements

X. INTERFACE SCHEDULE: Provide details of all BMS interfaces and connections to the work of other trades. Provide a Master Integration Plan which shall include the Network communications Topology between interfaced systems, Network Protocol, Alarmed Points, and the Sequence of Operations.

Y. LOCAL APPROVAL: Control devices and specific BMS which require approval of the local authorities having jurisdiction shall comply with such regulations. The BMS shall obtain approval of such prior to installation. Where filing is necessary, the expense shall be borne by the BMSC. Provide a copy of all related correspondence and permits/approvals to the Owner and A-E.

Z. ASBUILT DRAWINGS: Any revisions made during the installation, start-up, or acceptance portion of the project, shall be accurately reflected in the "as-builts". All BMS drawings shall be reviewed after the final system checkout and updated or corrected to provide 'Asbuilt' drawings to show exact BMS installation. All shop drawings shall be acknowledged in writing by the owner before installation is started and again after the final checkout of the system. The BMS installation shall not be considered complete until the 'asbuilt' drawings have received their final approval.

AA. OPERATION AND MAINTENANCE (O&M) MANUAL: Upon completion of the work of this Section, six (6) Hard and Two (2) Electronic copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative. The O&M manual electronic media shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1. POINT OF CONTACT: The O&M manual shall contain the names, address and 24 hour telephone numbers of the BMSC and service representative.
2. GUI SECTION: This section of the O&M Manual shall contain Step by step procedures for each operator function, including login, Creating, modifying, or deleting schedules, Uploading/Downloading to the field hardware, Creating historical trends, collecting trend data, and generating trend graphs, Enabling/Assigning alarms, and messages to reporting actions/groups, Report generation and ‘third party software’ and Backing up software and data files. All Color Printout of graphic screens shall be included.
3. BMS CONTROL DIAGRAMS: This section shall contain the BMS architecture overview and networking configuration, equipment controllers and diagrams, and the BMS software and hardware cut-sheets with product descriptions.
4. HARDWARE: Installation, mounting and connection details for all field hardware and accessories
5. COMMISSIONING: This section shall contain Commissioning, setup, and backup procedures for all control modules/accessories, BMS server software, and database. Provide the final testing and commissioning reports along with the device checklists.

6. MESSAGES AND ALARMS: This section shall contain a Listing of basic terminology, alarms/messages, error messages and frequently used commands or shortcuts. All alarm messages for equipment and operator action required.
7. SOFTWARE: This section shall contain System Software Documentation of all Graphical Language Programs, detailing their application to specific HVAC equipment, together library detailing the function. It shall include the Graphical relationship of the projects mechanical equipment hierarchy.
    1) Software Operating manuals.
    2) Control Device address lists
    3) Color Printout of software applications
    4) All Software licenses.
8. SYSTEM MAINTENANCE REQUIREMENTS: This section shall contain Maintenance instructions, recommended preventive maintenance procedures for all system components including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions. Provide a lists of spare parts for each type of control device, interconnection wiring diagrams with identified system components and devices. Provide the Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances. Include Calibration records and list of set points.
9. LICENSE AND WARRANTY: This section shall contain all BMS Licenses, Guarantee, and Warranty documents for all equipment and systems.
10. NOTICE OF COMPLETION: This section shall contain a document stating the date when the BMS is accepted for beneficial use and placed under warranty. At this time, the consultant shall issue a “notice of completion” and the warranty period shall start.
11. PRODUCT CERTIFICATES: Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.

1.010 QUALITY ASSURANCE

A. All bidders must be building automation Contractors in the business of installing direct digital control building automation systems for a minimum of 3 years.

1. The Building Management System Contractor shall have a full service facility within 50 miles of the project that is staffed with Engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The Contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.

B. All bidders must be authorized distributors or branch offices of the manufacturers specified.

C. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the Owner indicating that the installed system functions in accordance with the plans and Specifications.

D. The BAS system supplier shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.

E. The BAS system supplier shall provide a technician for 2 days manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS system supplier shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his Contract.

F. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.

G. Required elements of the startup testing include:
   1. Measurement of voltage sources, primary and secondary
   2. Verification of proper controller power wiring.
   3. Verification of component inventory when compared to the submittals.
   4. Verification of labeling on components and wiring.
   5. Verification of connection integrity and quality (loose strands and tight connections).
   6. Verification of bus topology, grounding of shields and installation of termination devices.
   7. Verification of point checkout.
   8. Each I/O device is landed per the submittals and functions per the sequence of control.
   9. Analog sensors are properly scaled and a value is reported
   10. Binary sensors have the correct normal position and the state is correctly reported.
   11. Analog outputs have the correct normal position and move full stroke when so commanded.

12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
14. Documentation of Loop tuning (sample rate, gain and integral time constant).

H. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following.
1. Graphics navigation.
2. Trend data collection and presentation.
3. Alarm handling, acknowledgement and routing.
4. Time schedule editing.
5. Application parameter adjustment.
6. Manual control.
7. Report execution.
8. Automatic backups.
9. Web Client access.

I. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

1.011 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.012 COORDINATION

1. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
2. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
3. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
4. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
5. Coordinate with the Owner's IT department on locations for ENC's, Ethernet communication cabling and TCP/IP addresses.

1.013 WARRANTY AND MAINTENANCE.

A. WARRANTY PERIOD: Labor and materials for control systems shall be warranted for a period as specified under Warranty in Section 00 72 00, General Conditions. Provide a two year labor and material warranty on the BMS. If within twenty four (24) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship, or materials, it shall be replaced, repaired, or adjusted at the option of the BMSC at the cost of the BMSC. THE BMSC shall maintain an adequate supply of repair devices within 50 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMSC's normal business hours.

B. START OF WARRANTY DATE: After the Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, the Engineer shall certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. The BMSC shall provide the owner in writing the Date of acceptance and the beginning of the warranty period.

C. SOFTWARE WARRANTY: The BMSC shall provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve identified software deficiencies at no charge during warranty period. Do not install updates or upgrades without Owner's written authorization.

D. WARRANTY - REMOTE SERVICE SUPPORT: As part of the warranty response, the BMSC shall be required to remotely connect to the facility's BMS during the warranty period. This remote connection to the facility shall be within two (2) hours of the time that the problem is reported to the BMSC. This coverage shall include normal or after business hours, weekends, and holidays. If the problem cannot be resolved with remote support services, the BMSC shall dispatch the qualified personnel to the project site to resolve the problem within 24 hours.

1.014 OWNERSHIP OF PROJECT MATERIAL.

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this Contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but

shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.

B. The licensing agreement shall not preclude the use of the software by individuals under Contract to the Owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under Contract to the Owner shall be restricted to use on the Owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.

C. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:

1. Server and workstation software
2. Application programming tools
3. Configuration tools
4. Network diagnostic tools
5. Addressing tools
6. Application files
7. Configuration files
8. Graphic files
9. Report files
10. Graphic symbol libraries
11. All documentation

1.015 WORK BY OTHERS

A. The BAS system supplier shall cooperate with other Contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others' work.

B. The BAS system supplier shall furnish all Control Valves, Flow Meters, Flow Switches, Sensor Wells for installation by the Mechanical Contractor and/or others.

C. The BAS system supplier shall provide field supervision to the designated Contractor for the installation of the following:

1. Automatic control dampers
2. Blank-off plates for dampers that are smaller than duct size.
3. Sheet metal baffles plates to eliminate stratification.
4. The Electrical Contractor shall provide:
    a. All 120VAC power wiring to motors, heat trace, junction boxes for power to BAS panels.
    b. Furnish smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS system supplier to hardwire to fan shut down.
    c. Auxiliary contact (pulse initiator) on the electric meter for central monitoring of kWh and KW. Electrical Contractor shall provide the pulse rate for remote

readout to the BAS. BAS system supplier to coordinate this with the electrical Contractor.

D. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

E. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Bid Documents.

F. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

PART 2 - PRODUCTS

2.01 BUILDING MANAGEMENT SYSTEM MANUFACTURERS

A. MATERIAL SAMPLES: Due to the unique nature of the project, all equipment for this building will be special, minimal size, and with special colors. All components for the project will require samples as part of the approval process.

B. ACCEPTABLE MANUFACTURERS: The BMS architecture shall consist of the products of a manufacturer regularly engaged in the production of DDC Control Systems and shall be the BMS manufacturer's latest standard of design at the time of bid. All controls, other than relays, transformers and panels shall be the product of the same manufacturer. The basis of design for the BMS is the Niagara Platform as manufactured by Honeywell Controls (Forge-WEBs-N4) as provided by an ACI-DIRECT.

C. NON-COMPLIANT AND UNACCEPTABLE SYSTEMS: Any BMS provided by single sourced, or equipment manufacturer provided control systems (e.g., York, Carrier, Daikin, Trane, etc...), any of the approved BMS manufacturers which utilize proprietary controls, Non-Open Source or Not-Open Systems or requests which have not received the Engineers written approval as detailed in Part 1 of this section shall not be acceptable.

2.02 SYSTEM DESCRIPTION

A. OVERVIEW: The BMS specified in this document shall be Web-based, utilizing the Open Source – Open System Niagara Platform. The Building Management System (BMS) shall be comprised of interoperable SNC, AAC, ASC DDC Controllers, customized 3-D graphics and graphical process programming direct digital controllers, software, and other control devices for a complete BMS as specified herein. The BMS shall use a Niagara N4 Platform architecture and shall integrate a wide variety of third-party devices and applications. UM's DDC devices shall be integrated to the N4 Platform through a common protocol. Equipment graphics shall be generated and included on the Web-based Graphical User Interface.

B. SPECIFIC PROJECT REQUIREMENTS:

1. No Proprietary communications protocol at any level.
2. All Hot Water valves shall fail open to the coil.
3. All valve actuators shall have a mechanism for local manual override at the unit.
4. All modulating control valves shall be 0-10VDC or 4-20mA.
5. All System Equipment Graphics, including Floor plans shall be depicted in a 3-D aspect.
6. All Graphical Floor plans shall be thermographic, changing color as deviation from setpoint.
7. High Priority alarms, as defined by the Owner, shall provide an escalation text or email.

C. ENVIRONMENTAL CONDITIONS FOR DEVICES: Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

D. DDC SYSTEM RELIABILITY: Design, install and configure DDC controllers, gateways, routers to yield a MTBF of at least 20,000 hours, based on a confidence level of at least 90 %. MTBF value shall include any failure for any reason to any part of products indicated. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under

automatic control. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated on Drawings.

E. ELECTRIC POWER QUALITY: Protect primary network and critical system DDC controllers which are connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41. Fuses shall not be utilized for surge protection.

F. POWER CONDITIONING: Protect primary network and critical system DDC controllers which are connected to AC power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be such that at 85 % load, output voltage shall not deviate by more than plus or minus 1 % of nominal when input voltage fluctuates between minus 20 % to plus 10 % of nominal. During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 % of nominal. Accomplish full correction of load switching disturbances within five cycles, and 95 % correction within two cycles of onset of disturbance. Total harmonic distortion shall not exceed 3-1/2 % at full load.

G. GROUND FAULT: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

H. BACKUP POWER SOURCE: HVAC systems and equipment served by a backup power source shall have the associated DDC controllers/devices providing control of them also served from a backup power source.

I. UNINTERRUPTABLE POWER SUPPLIES (UPS): UPS units shall provide emergency transfer power to critical DDC system including DDC controllers, input and output device and sensors and actuators. Typical equipment include Archival Servers, SNC, Critical System DDC controllers, Graphical Operator Workstations, Alarm Printers, Network Routers and System Gateways.

J. OPERATION AFTER ELECTRIC POWER INTERRUPTION: Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.03 BUILDING MANAGEMENT SYSTEM NETWORK ARCHITECTURE

A. GENERAL: The BMS shall be comprised of a network of interoperable, standalone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein. The BMS shall provide secure password access to all features, functions and data contained in the overall BMS. The BMS is based in the Honeywell (WEBs-N4) BACnet architecture. The BMS shall integrate a wide variety of third party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other Owner provided networks.

B. NETWORK ARCHITECTURE: The system shall utilize an open architecture consisting of no more than three (3) network tiers capable of the following:

1. Utilizing TCP/IP communications operating at a minimum speed of 100 Mb/sec.
2. ANSI/ASHRAE BACnet Standard 135 protocol shall be sole and native protocol used throughout entire DDC system.
3. If used, gateways shall connect to the system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Operator Workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.
5. The networks shall utilize only copper and optical fiber communication media as appropriate and shall comply with applicable codes, ordinances, and regulations.
6. All necessary TCP/IP connections and Internet Services shall be provided by the Owner.
7. The Tier one (1) LAN shall connect network controllers and operator workstations.
8. The Tier two (2) LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
9. The Tier three (3) LAN shall connect application-specific controllers to programmable application controllers and/or network sensors.
10. Portions of the system networks integration may use an Open implementation of network devices and technology complying with Modbus Application Protocol Specification V1.1b.

C. COMMUNICATION SPEED:

1. LAN Connecting OWS and SNC: 100 Mbps.

2. LAN Connecting BC: 100 kbps.

3. LAN Connecting AAC and ASC: 76,800 bps.

D. DEDICATED NETWORK: The BMS shall consist of dedicated and separated LANs that are not shared with other building systems and tenant data and communication networks.

E. EXPANSION CAPABILITY: The BMS's architecture shall be modular and have inherent capability to expand to not less than two times system size indicated with no impact to performance. The BMS shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers, and operator devices. A sufficient number of DDC controllers shall be supplied to fully meet the project requirements of this Specification. The BMS network shall support 25% expansion capacity of all types of Niagara N4 DDC controllers, and all point types included in the initial installation.

F. TRANSPARENCY: The number of LANs and associated communication shall be transparent to the Operator. All I/O points residing on any LAN shall be capable of global sharing between LANs.

G. INDEPENDENT CONTROL AND RESILIENCY: The BMS's network design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices. Each Niagara N4 DDC controller shall operate independently, performing its' own control, alarm management and historical data collection. The individual elements and component subsystems shall be minimum requirements and shall be augmented as necessary by the BMSC to achieve compliance with all applicable codes and standards.

H. The BMS shall consist of the following:

1. System Network Controllers(s)(SNC)
2. Operator Workstations (OWS)
3. Graphical User Interface(s)(GUI)
4. Local Display Device(s)(LCD)
5. Building, Advanced and Application System Controllers (B-BC/B-AAC/B-ASC)
6. Input/Output Module(s)(IOM)

7. Network communications equipment
8. Other components required for a complete and working BMS

2.04 OPEN, INTEGRATED, AND INTEROPERABLE.

A. OVERVIEW: The design intent is to provide an Open Source - Open BMS utilizing distributed web based direct digital controls which communicate over a BACnet communications network. The BMS's BACnet controllers, materials and components furnished shall be unrestricted and available for acquisition by the Owner through multiple independent sources and service providers. The Contractor shall provide the sources and providers to the M-E-P, upon request.

B. NETWORK COMMUNICATIONS PROTOCOL: Network communication protocol(s) used throughout entire DDC system shall be open and available to other companies for use in making future modifications to DDC system. The Honeywell WEBs-N4 DDC Controllers shall reside on the BACnet communications sub-network.

C. HIERARCHICAL NETWORK TOPOLOGY: A hierarchical network topology is required to assure reasonable system response times and to manage the flow and sharing of data, without unduly burdening the Owner's internal Intranet network.

D. PEER TO PEER DDC CONTROLLERS: All DDC controllers supplied under this Contract shall be true "peer to peer" communicating devices. DDC controllers requiring "polling" by a host to pass data shall not be acceptable

E. OPEN GRAPHICAL OBJECTS: The BMS GPL software shall employ object oriented technology (OOT) for representation of all data and control devices within the system.

F. OPEN DATABASE CONNECTIVITY: An Open Database Connectivity (ODBC) or Structured Query Language (SQL) server database is required for all data storage. The BMS system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary interface, programs, or browser plugins. Any BMS system which provides or requires a proprietary database or user interface program shall not be acceptable.

2.05 WEB BROWSER BACnet ADVANCED OPERATOR WORKSTATION (B-AWS)

A. OVERVIEW: The Advanced Operator Workstation shall provide the Operator comprehensive control and monitoring of the BMS via a standard Web Browser interface by using a collection of web pages. The Web pages shall be constructed to "feel" like a single application and provide a complete and intuitive control of the BMS. The intent is to provide the operator(s) complete access to the BMS system via a web browser. The web browser shall be operating system agnostic, meaning it shall support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plugins. The web browser GUI shall provide a completely interactive user interface for navigation, and display of dynamic animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus, data archiving, reports and reporting actions.

B. SOFTWARE COMPONENTS: The system software shall be latest version as part of this project and shall include:

1. Server Software and Database Software
2. Embedded Web Graphics.
3. Embedded System Configuration Utilities for future modifications
4. Embedded Graphical Programming Tools.
5. Embedded Direct Digital Control software.
6. Embedded Application Software.
7. A five (5) Year Software Maintenance license shall be included. Labor to implement shall be additional.

C. USER LOGIN: A Web link shall direct the web-browser to the BMS's domain name or IP address, Login web page. The Operator shall be required to enter their unique login name and strong password to gain access.

D. NAVIGATION: Navigation within system shall be dependent on the Operator's assigned Role Based application control privileges. Navigation shall be accomplished by selecting the navigation tree which consists of expandable and collapsible tree control and/or by selecting dynamic links to other system graphics. The Navigation tree shall as a minimum provide the following views:

1. A Geographic View which displays a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment, and objects.
2. A Network View which displays a logical Network hierarchy of the BMS including B-BCs, B-ASCs, B-VAVs.
3. A Group View which displays the Scheduled Groups and any Custom reports.
4. A Configuration View which displays all the interface categories, including Operators, Schedule, Events, Reporting, and Roles

E. ACTION PANE: Web Graphics shall use a 3-D perspective graphics format suitable for display in a web browser, the system graphics shall include an overall site/building/campus views, building floor plans, equipment Drawings, active graphic setpoint controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.

1. Dashboards shall allow the Operator to interface with customizable data using drag and drop HTML5 elements. The elements shall include Web Charts, Gauges, and other custom developed widgets for use in a web browser. The Operator shall have ability to save custom dashboards.
2. Search feature shall provide the Operator with options for searching data based upon tags, associated equipment, real time data, properties, and trends.
3. Properties of the system shall include graphic controls, locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the Operator to depress an 'accept/cancel' button.
4. Schedules shall provide the Operator to create, modify/edit and view schedules based on the systems hierarchy.
5. Alarms shall provide the Operator alarm information geographically, acknowledge alarms, sort alarms by category, actions and verify reporting actions.
6. Charting shall provide the Operator a display of associated trend and historical data, modify colors, date range, axis, and scaling. The Operator shall have ability to create HTML charts through web browser without utilizing chart builder. The Operator shall be able to drag and drop data points, schedules, and apply status colors for analysis.
7. Logic - Live Graphical Language Programs shall displayed dynamically 'live', for each of the control algorithm, (micro-block programming) for the system selected in the navigation tree.

8. Other actions such as Print, Help, Command, and Logout shall be available via a drop down window.

F. CUSTOMIZED 3 DIMENSIONAL COLOR GRAPHICS: Tools required to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria, as a minimum:

1. The Web pages shall make extensive use of color to communicate information related to the system setpoints and controls parameters.
2. Animated gifs or jpg, vector scalable, active set point graphic controls shall be used to enhance usability.
3. The Web-page display shall be uniform in size and depth of color, a standardized graphically display shall be 1024 by 768 pixels, 24 bit True Color.
4. System Graphics Requirements (minimum):
    a. An area map or individual Building Overview graphic shall be provided which shall show locations of controlled buildings in relation to local landmarks.
    b. Detailed Floor Plans graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
    c. Unique Mechanical Systems graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.

G. SECURITY ACCESS: Access to the system shall require a Login Name and Strong Password. Access to different areas of the system shall be by the defined Operator Role and Access Control privileges.

1. Operator Roles shall reflect the expected interface Roles of Operators of the system. Each Operator Role shall comprise a set of privileges defined in terms of Viewing, Editing or Functions.
2. Operator View Privileges shall comprise Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.

3. Operator Edit Privileges shall comprise Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
4. Operator Function Privileges shall comprise Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
5. Operator Geographic Assignment of Roles shall be assigned using a similar geographically expandable/collapsible navigation tree. I.e. it shall be possible to assign two HVAC Technicians with similar defined HVAC Roles, differing system geographical areas access.

H. HIERARCHICAL SCHEDULES: Utilizing the Navigation Tree displayed in the web browser GUI, an Operator shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room or choose to apply a hierarchical schedule to the entire system, site, or floor area. I.e. Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system /area / equipment shall be highlighted in the Navigation Tree and shown in a summary schedule table and graph.

1. Schedules Types & Standards: Schedules shall comply with the BACnet LonWorks standards. (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
    a. Types of schedule shall be Normal, Holiday or Override.
    b. A specific date or a range of dates.
    c. Any combination of Month of Year, Week of Month, or Day of Week .
    d. Wildcard (i.e. allow combinations like second Tuesday of every month).
2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
3. Schedule Groups: Operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site.

4. Intelligent Scheduling: The system shall automatically turn on any supporting equipment needed to control the environment in an occupied space.
5. Partial Day Exceptions: Events shall be able to accommodate a time range specified by the operator.
6. Summary Schedule Graph: The schedule summary graph shall show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules.

I. ALARMS (OR EVENTS): Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:

1. An Alarm View which shall display the Alarms Category with a unique icon, the date/time of occurrence, current status, alarm report and a URL link to the associated graphic for the selected system, area, or equipment. The URL link shall indicate the system location, address, and other pertinent information. An Operator shall easily be able to sort events, edit event templates and categories, acknowledge, or force a return to normal in the Events View.
2. An Alarm Categories which shall allow an Operator to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. A unique icon shall be associated with each alarm category.
3. An Alarm Template which shall allow an Operator to define the type of alarm and its properties. The Alarm properties shall include a reference name, a verbose description, the severity of alarm, any acknowledgement requirements, and limits and out of range information.
4. An Alarm Area which shall allow an Operator to assign specific Alarm Categories to specific Alarm Reporting Actions.
5. An Alarm Time/Date Stamp which shall be generated by the controller’s RTC Time/Date.
6. Alarm Configuration which shall allow an Operator to define the type of Alarm generated per object.
7. Alarm Summary Counter shall allow a view of Alarms in the Graphic Pane with a numeric counter, indicating how many Alarms are active, require acknowledgement and total number of Alarms in the Archival database.

8. Alarm Auto Deletion that are acknowledged and closed shall be auto deleted from the database and archived to a text file after an Operator defined period.

J. ALARM REPORTING ACTIONS: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the system. The system Operators shall be able to define the Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall inform the Operator of an Alarm by the following actions:

1. A hard-copy printing to a network printer.
2. An E-mail sent to one or more email accounts on a POP3 compatible server.
3. An alphanumeric paging services, where POP3 email servers support pagers.
4. An ASCII File write reporting action to append Operator defined alarm information to through a text file.
5. A write property value in a system network controller.
6. A Simple Network Management Protocol (SNMP) to an SNMP trap.
7. Run an external software program

K. GRAPHICAL TRENDS: Trends shall be enabled for all controller hard I/O points. Point Data shall be collected locally by the controller, the data shall be uploaded to the data archival server periodically. The Operator shall have the ability to view ‘Live’ and historical trend data. The Trend data shall be comprised of analog, digital or calculated points, allowing for configuration and displaying multiple trends simultaneously trends through a web-browser. Each point shall have the ability to be collected at different trend intervals. The Trend resolution shall automatically scale the X-axis and Y-axis when multiple trend points are selected which have different trend intervals or ranges. When Trend data collection is viewed ‘Live’, the Trend graphic shall update dynamically. The Trend Graphic shall allow the Operator to zoom in on a particular section of a trend and scroll through' historical archived data graphically. The data value shall be imposed on the Trend graphic when any the point sample is selected. The Operator shall through the use of standard keystrokes (CTRL+C, CTRL+V), be able to copy the data.

2.06 GRAPHICAL PROGRAMMING LANGUAGE (GPL)

A. OVERVIEW: The Graphic Programming Language (GPL) for all DDC control algorithms shall be resident in all of the BMS controller modules. Any BMS that does not use a drag and drop method of graphical icon programming shall not be acceptable.

B. GPL PROGRAM DESIGN: All BMS systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. GRAPHIC SEQUENCE: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the Specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

D. GRAPHICAL PROGRAMMING LANGUAGE (GPL) CAPABILITIES: The following is a minimum definition of the capabilities of the GPL software:

1. Function Block (FB): A collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.

3. Microblocks: A software device that are represented graphically and may be connected together to perform a specified sequence.
4. Wires: Graphical elements used to form logical connections between microblocks and between logical I/O.
5. Reference Labels: Similar to wires, in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a Drawing are logically connected even though there is no wire between them.
6. Parameter: A value that may be tied to the input of a microblock.
7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.
8. Icon: A graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu bar Icon: An icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: All input/output data, calculated data and set points shall be displayed in a 'live' real time mode.

2.07 SYSTEM NETWORK DEVICES

A. Operator Workstation (OWS):
   1. Processor: I7 Quad core 3.2 GHz.
   2. Onboard RAM: Capacity: 2x16 GB.
      a. Speed and Type: DDR4 1800 MHz
      b. Expandable Capacity: 64 GB
   3. Internal Hard Drives: (1) 2 TB.
      a. Minimum Average Seek Time: <10ms.
      b. Cache Buffer Size: 256K.
      c. MTBF of 100,000 power-on hours.
   4. Backup BD/RW Drive: (1)
      a. 2 MB of data buffer.

b. Average access time of 150 ms or less.

c. MTBF of 100,000 power-on hours.

5. Graphics Card: 1920 x 1080 pixels at 60 Hz. Energy Star compliant.

6. Network Card: (1) 100/1000 Mb TCP/IP adapter.

7. Ports: (4) 2.0 USB (2) 3.0 USB

8. Interface accessories:

a. Wireless 101 enhanced Keyboard, Full upper- and lowercase ASCII keyset, numeric keypad, and 12 programmable function keys.

b. Wireless 3 Button Mouse, w scroll wheel, Optical.

c. Wireless operation within up to 72 inches in front of workstation.

B. Graphics Monitor:

1. LED Color display with 24" diagonal viewable area.

2. Resolution: 1920 x 1080 pixels at 60 Hz.

3. Input signal: HDMI

4. Aspect Ratio: 16 to 9.

5. Antiglare display.

6. Dynamic Contrast Ratio: 50000 to 1.

7. Brightness: 250 cd/sq. m.

8. Tilt adjustable base.

9. Energy Star compliant.

10. Include applicable cabling to connect devices.

C. THIN CLIENT WEB STATIONS (TCWS): A current released open browser (Explorer/Firefox/Chrome) shall only be required as the GUI and a valid connection to the server network. No installation of any custom or special software shall be required to be installed to access the BMS via a web browser. Local and Remote interface shall from a Web Browser and the BMS shall be over a TCP/IP LAN or WAN connection and offer encryption using 128 bit encryption within Secure Socket Layers (SSL). Communication protocol shall be Hyper Text Transfer Protocol (HTTP). The Thin Client Web stations shall include the following components:

1. Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+.

2. Graphical Display: Video card & LCD monitor 1024 x 768 resolution or greater.

3. Network Support: 100/1000 Mb TCP/IP adapter.
4. Processor, Memory and Hard Drive capacities: As desired by Owner.

D. ROUTER AND SWITCHES (100/1000 MBPS): The BMS network router/switches shall connect directly to the architecture using standard TCP/IP protocol at a minimum of 100 mbps and shall provide communication connections between individual SNCs, Servers, OWS and other TCP/IP networked devices.
1. Manufacturers:
   a. Cisco.
   b. Or approved equal.

2.08 UNINTERRUPTABLE POWER SUPPLY (UPS):

A. BACKUP POWER CAPACITY SIZING: The Uninterruptable Power Supply shall be sized to provide the equipment with a minimum backup power for 15 minutes at full load. The UPS shall conform to Class 2 overcurrent protection.

B. POWER LINE FILTERING: The UPS shall have combined 1 percent line and load regulation with 100 micro-second response time for 50 percent load changes. Built in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure. Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse mode noise attenuation of 65 dB.
4. Minimum common mode noise attenuation of 150 dB at 40 to 100 Hz.

C. Manufacturers:
1. Approved equal.

2.09 SUPERVISORY NETWORK BUILDING CONTROLLER (SNC)

A. OVERVIEW: The Supervisory Network Building Controller(s) (SNC) are designed to manage communications between itself and other peer-to-peer Supervisory Network Controllers (SNC) and with any BMS BACnet TCP/IP, SNMP and Niagara 4 Fox networked connected Operator

workstations (OWS) that are part of the BMS. Additionally, the Supervisory Network Building Controller(s) (SNC) are to manage the communications between its communications sub-network Building Level controller(s) (B-BC), Advanced Application Controller(s) (B-AAC), and Application Specific Controller(s) (B-ASC). The SNC shall perform control and operating strategies for the various HVAC and integrated systems controlled utilizing information from any of the distributed DDC controllers connected to the BMS. The SNC shall be fully programmable to meet the unique requirements of the facility. The use of a proprietary communication protocol for peer to peer communications between SNC's shall not be acceptable.

B. OPEN PROTOCOLS (STANDARD): The SNC shall be provided with BACnet, LON, Modbus, N2, SNMP, KNx Open Communications protocols by default.

C. EMBEDDED SOFTWARE: The SNC shall have embedded "Setup Wizards" controller programming software

D. STANDARD PROGRAMS: The SNC shall be capable of executing application control programs to provide:
   1. Calendar functions.
   2. Scheduling.
   3. Trending.
   4. Alarm monitoring and routing.
   5. Time synchronization.
   6. Integration of LonWorks, BACnet, and MODBUS controller data.
   7. Network management functions for all SNC, PEC and ASC networked devices.

E. HARDWARE FEATURES: The SNC shall provide the following hardware features as a minimum:
   1. Ports: Two 10/100 Mbps Ethernet ports/ Two Isolated RS-485 ports with biasing switches.
   2. One USB Flash Drive
   3. Onboard Memory: 1 GB RAM / 4 GB Flash Total Storage / 2 GB User Storage
   4. MicroSD Memory Card with Encrypted Safe Boot Technology
   5. Wireless: Wi Fi (Client or WAP)
   6. Expansion Bus: High Speed Field Bus Expansion

7. Operating Temperature: Minus 4 to 140 degrees F Ambient
8. Integrated 24 VAC/DC Power Supply

F. CONNECTIVITY: The SNC shall support standard Web browser access via the LAN/WAN network, supporting a minimum of 16 simultaneous users.

G. ALARMING: The SNC shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network, remote via cellular modem, or wide area network. Alarm generation shall be selectable for annunciation type and acknowledgement requirements. Alarms shall be annunciated in any of the following manners as defined by the user:

H. DEVICE SECURITY: The SNC shall support the following security functions. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted. Role Broadcast Access Control (RBAC) for managing user roles and permissions. Require users to use strong credentials. Data in Motion and Sensitive Data at Rest be encrypted. LDAP and Kerberos integration of access management.

I. DATA STRUCTURES: The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality: Metadata: Descriptive tags to define the structure of properties. Tagging: Process to apply metadata to components. Tag Dictionary

J. DATA TEMPLATES: The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit controlled upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD…) shall have an associated template file for reuse on future project additions.

K. SOFTWARE SUPPORT: The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.

2.010 BACNET APPLICATION SPECIFIC CONTROLLER (B-ASC)

A. Controller Applications: Application of the B-ASC controller include Unit Ventilators, Fan or Blower Coil Units, Heat Pump Units, Natural Convection units, Radiant panels, Room Pressure control (Regulated volume (pressurization/de-pressurization), Temperature, humidity, dispersed CO2, occupancy, and emergency control.

B. The Application Specific Controller (B-ASC) shall be designed specifically to allow for specific application with the capability for custom programming to control the BMS's equipment.

C. All B-ASC programming shall comply with standard application programmable and shall at all times maintain their certification. All control sequences within or programmed into the B-AAC shall be stored in non-volatile memory. Device dependent upon the presence of a battery for memory retainage shall not be acceptable.

D. Minimum Hardware Functional Requirements: The B-ASC shall be capable of either integrating with other devices or standalone room level control operation. The B-ASC shall have an internal time clock with the ability to automatically revert from a master time clock on failure.

E. BACnet: The control of the equipment shall be accomplished using a BACnet direct digital controlled devices with BTL listed PICS.

F. PROGRAMMING FUNCTIONAL REQUIREMENTS:

1. Minimum Programming Functional Requirements: The B-ASC shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the Niagara 4 environment. B-ASC s shall support at minimum the following control sequences:
    a. General purpose control loops, linear and non-linear
    b. Demand Limit Control strategies,
    c. Setpoint reset
    d. Adaptive intelligent recovery
    e. Time of Day Reset.
    f. Start/Stop/Status loops.
    g. Boolean Logic functions (i.e. If/Then/Else ladder logic)

h. Math Function loops.

2. The B-ASC controller shall have standard and custom HVAC programs which shall be modifiable to provide the Division 15 Section “HVAC Equipment Sequence of Operations".
3. The B-ASC controller shall maintain the Native Graphical Programming Language and graphics, fully programmable and configurable from any Niagara N4 Framework™ platform, not requiring any external configuration or programming tool. The Native programming software and “Setup Wizard” shall be embedded within the controller.
4. The B-ASC controller shall allow downloads and uploads from any Niagara N4 Framework™ platform, including providing offline program simulation.
5. The B-ASC controller shall be part of a networked system or allow for standalone operation.
6. The B-ASC controller shall provide continuous Adaptive Integral Algorithm Control Loop tuning.
7. The B-ASC controller shall have a loop execution response time of 1 second.
8. The B-ASC controller shall have a software notifications, when connected to a network:
   a. Significant Event Notification
   b. System Periodic Update
   c. Detection of Network Failure.
9. The B-ASC controller shall provide for “user defined” Network Variables (NV) for customized configurations and naming using Niagara N4 Framework™.
10. The B-ASC controller shall support 240 Network Variables with a byte count of 31 per variable.
11. The B-ASC controller shall support 960 separate data values.

G. Hardware Functional Requirements:

1. Control Processors: The B-ASC controller shall have two microprocessors, Host and Comm. The Host processor shall provide FLASH memory for HVAC application programming, with RAM memory for HVAC program execution and data storage. The FLASH memory shall be retained for a minimum of ten years, a battery for memory retainage shall not be acceptable. The Comm processor shall manage the network communications.

2. Environmental Ratings: The B-ASC controller shall be function within an operating environment of 32 to 122 degrees F and 5 to 95 percent relative humidity, non-condensing.
3. Approvals and Listings: The B-ASC controller shall have the following certifications, listings, and approvals:
    a. BACnet Application Specific Controller (B-ASC)
    b. FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    c. UL916 (Open Energy Management Equipment) with plenum rating.
    d. CSA (LR95329-3) Listed
    e. Canadian Standard C108.8 (radiated emissions).
    f. European Consortium standards: EN 61000-6-1; 2001 EN 61000-6-3; 2001
4. Device Status Indication (Host): A visible LED shall provide indication of the internal program functional status.
    a. Controller - Operating normally.
    b. Controller - In process of program download.
    c. Controller - In manual mode, under control of software tool.
    d. Controller - Lost Configuration.
    e. Controller – Low or No power, possible damage
    f. Controller - Host Processor not operating.
5. Bus Status Indication (Comm): A visible LED shall provide indication of the B-ASC controller's communication status:
    a. Bootloader running - MS/TP communication is present.
    b. Bootloader running - MS/TP token is not present.
    c. Bootloader not running - Processor missing bootloader image.
    d. Communications - Processor is not running
6. Internal Real Time Clock (RTC): The B-ASC controller shall have an internal Real Time Clock (RTC). The RTC shall allow for stand-alone operation or reference if Network Master Time clock communication function is interrupted. The RTC shall provide 24 hours, 365 days, multi-year calendar, day of week, including automatic daylight savings, configured for start and stop dates scheduling. The RTC shall have a time accuracy of plus or minus 1 minute per month at 77 degrees F and shall maintain its settings upon a loss of device power for a minimum of 24 hours at 32 to 122 degrees F.

7. Housing: The housing shall be UL plenum rated, with panel of din rail mounting.
8. Terminal Connections: The B-ASC controller's wire connectors shall allow for quick disconnection of external wiring, without removing the wire from the connector. The wire connectors shall have color coded labels.
9. Field Wire connections: The B-ASC controller shall have Digital Inputs (DI), Digital Outputs (DO), Analog Outputs (AO), Universal Inputs (UI), Internal Velocity Pressure sensor, and damper actuator (optional), as required to meet the Sequence of operations.
    a. The Universal inputs (UI) shall be configurable as binary N.O./N.C. inputs, analog resistive inputs (0 to 10K or 20K ohm NTC), analog voltage inputs (0 to 10 VDC), or analog current inputs (4 to 20 mA).
    b. The Digital Inputs (DI) shall be configurable as N.O., N.C or 15 Hz pulse counters.
    c. The Analog outputs (AO) shall be configurable as 0 or 2 to 10 Vdc or as 4 to 20 mA.
    d. The Digital Outputs (DO) shall be configurable as N.O. or N.C. and rated to switch 30 Vac/Vdc at 500 mA, or Relay outputs, (RO) rated for 1 Amp.
10. Communications Field Bus: The B-ASC controller shall a two wire, polarity insensitive communication via bus which provides 18 Vdc power and communications between enabled devices
11. Onboard Power VDC Supply: The B-ASC controller shall have one (1) integral 20 VDC 75 mA power supply, plus or minus 10 percent for external sensors. If the controller lacks a comparable internal power supply, a fully isolated, enclosed, current limited and regulated UL listed DC power supply for each shall be provided.

2.011 SYSTEM INPUT SENSORS

A. GENERAL REQUIREMENTS: Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. TEMPERATURE SENSORS (TS): Room Temperature sensors shall be provided as shown on project plans, or where temperature control is required for the equipment. Room Temperature sensors shall have a decorative cover provided for surface or wall box mounting. A metal ventilated plate type cover shall be provided, where conditions indicate damage is

most likely to occur. Room Temperature sensors shall have a range of 30 to 90 degrees F, with an accuracy of plus or minus 0.5 degrees F.

1. Acceptable Room temperature sensor types are:
    a. 1000 ohm nickel thermistor
    b. 1000 ohm platinum thermistor.
    c. 20K ohm thermistor
2. Where local adjustment are required, an LCD display with four button keypad shall provide the following capabilities:
    a. Display room and outside air temperatures.
    b. Display and adjust room comfort setpoint.
    c. Display and adjust fan operation status.
    d. Timed override request push button with LED status
    e. Display controller mode.
    f. Password selectable adjustment of setpoint and override modes.
    g. A communication port.
3. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Or approved equal.

C. IMMERSION TEMPERATURE SENSORS (TS-I): Immersion Temperature sensor shall contain an 20K ohm thermistor to monitor water temperature.

1. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Or approved equal.

D. OUTSIDE AIR TEMPERATURE SENSOR (OAT): Outdoor Air Temperature Transmitter shall contain a 20K ohm thermistor temperature sensors with an accuracy of plus or minus ; 0.5 degrees F mounted in an enclosure rated for outdoor use. A solar shield shall be provided for each sensor. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element. These devices shall have accuracy of plus or minus 0.5 degrees F over the entire range.

1. Acceptable Manufacturers:
    a. Honeywell Controls.

b. Or approved equal.

E. TEMPERATURE SENSORS - DUCT MOUNTED PROBE (TS-D): Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair.

1. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
2. Duct Type Temperature sensor shall be 20K ohm thermistor temperature sensors with an accuracy of plus or minus ; 0.5 degrees F, moisture resistant for mounting into a duct.
3. Duct mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of minus 40 to 160 degrees F. Duct sensors shall be rigid or averaging as shown on the project BMS diagrams. Averaging sensors shall be a minimum of 5 feet in length. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet long sensor element
4. The operating range shall be as indicated with an accuracy of plus 1 percent over the full range. The output shall be compatible with the panel it serves.
5. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
6. Acceptable Manufacturers:
   a. Honeywell Controls.
   b. Or approved equal.

F. TEMPERATURE SENSOR – DUCT MOUNTED AVERAGING (TS-A): For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.

1. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12 foot long segment.
2. Capillary supports at the sides of the duct shall be provided to support the sensing string.
3. Duct Averaging Type Temperature Transmitter shall be a general purpose RTD sensing element, moisture resistant transmitter for mounting into a duct. The operating range

shall be as indicated with an accuracy of plus 1 percent over the full range. The output shall be compatible with the panel it serves. Transmitter shall be with 17 feet of sensor capillary.

4. Manufacturers:
    a. Honeywell Controls.
    b. Or approved equal.

G. STATIC PRESSURE TRANSMITTERS, AIR (SPT): Stainless steel diaphragm construction, Suitable for service medium, Non-directional sensor with suitable range for expected input, and temperature compensated.

1. Action: Direct acting.
2. Accuracy: 2 percent full scale with repeatability of 0.5 percent.
3. Output: 4 to 20 mA.
4. Building Range: 0 to 0.25 inch wg.
5. Duct Range: 0 to 5 inch wg.
6. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Or approved equal.

H. DIFFERENTIAL PRESSURE TRANSMITTERS (DPT):

1. General Pressure Transmitter Requirements:
    a. Range: Selection to provide full coverage of the to the measured range.
    b. Over Pressure protection: 100 percent pressure range
    c. Outputs: 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
    d. Housing: Rated for local environment, minimum NEMA-1.
    e. Reference Accuracy: ± 1 percent of full scale.
    f. Zero & span: .04 percent linearity, hysteresis, and repeatability.
    g. Accuracy Range: 20 to 1 ratio turndown.
    h. Thermal Effects: less than .033 ° F over 40 to 100 ° F.
    i. Static Pressure Effect: 0.5 percent fill scale.
    j. Features: Non-interactive zero and span adjustments adjustable from the outside cover.

k. Auxiliary devices: Air bleed and bypass valve assembly with shut off valves in the sensing lines.

2. Acceptable Manufacturers:
   a. Honeywell Controls.
   b. Veris.
   c. Setra.
   d. Or approved equal.

I. CARBON DIOXIDE SENSOR (CO2): The carbon dioxide sensor (CO2) shall be rated for the design application. The CO2 sensor shall measure the carbon dioxide concentrations and shall work on the non-dispersive infrared (NDIR) operating principle with either an ambient or duct gas sampling method. The CO2 sensor shall be monitored by the BMS. The CO2 sensors shall have a local LED readout of the ppm of CO2.The BMS shall trend the CO2 concentration of each system over a 24 hour period.

1. Wall Carbon Dioxide Sensors
   a. Wall Carbon Dioxide Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.) with the following features:
      1) Response time: less than one minute.
      2) Range: 0 to 2000 PPM CO2
      3) Accuracy: plus, or minus 5 percent or 75 PPM
      4) Output: Jumper Selectable: 0 or 4 to 20 mA, 0 to 10 VDC.
      5) Operational Temperature: 15 to 130 degrees F
      6) Housing: High impact plastic enclosure.
   b. Relay Output (Optional)
      1) Contact Rating: N.O. or N.C. operation, Max 30 VAC, 0.5 A, Class 2.
      2) Resolution: 10 ppm
   c. Recommended External Load:
      1) Current Output: 4-20mA, Maximum 500 ohm load resistance.
      2) Voltage Output: 0-5VDC, Minimum 1,000 ohm load resistance.
   d. Power Supply Range: 20 to 30 VAC (18 to 30 VDC), Class 2.
   e. Operating Life Expectancy: 10 Years
2. Duct mount CO2 transmitter:

a. Duct Carbon Dioxide Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.) with the following features:

1) Response time: less than one minute.

2) Range: 0 to 2000 PPM CO2

3) Accuracy: plus, or minus 5 percent or 75 PPM, whichever is greater.

4) Output: Jumper Selectable: 0 to 20 mA, 4 to 20 mA, 0 to 10 VDC.

5) Operational Temperature: 15 to 130 degrees F

6) Housing: High impact plastic enclosure.

b. Relay Output (Optional)

1) Contact Rating: Maximum 30 VAC, 0.5 A, Class 2.

2) Resolution: 10 ppm

c. Recommended External Load:

1) Current Output: Maximum 500 ohm load resistance.

2) Voltage Output: Minimum 1,000 ohm load resistance.

d. Power Supply Range: 20 to 30 VAC (18 to 30 VDC), Class 2.

e. Operating Life Expectancy: 10 Years

3. Acceptable Manufacturers:

a. Honeywell Controls.

b. Senva.

c. Or approved equal.

J. CURRENT SWITCHES (CS):

1. Current actuated switches shall be self-powered, solid state with an adjustable trip current.

2. The switches shall be selected by the BMSC to match the application and output requirements of the DDC system.

3. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output.

4. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device.

5. It shall accept over current up to twice its trip point range.

6. Approved applications of current sensing switches include monitoring of run status for fans, pumps, and other miscellaneous motor loads.
7. The Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
8. Acceptable manufacturers:
    a. Honeywell.
    b. Senva.
    c. Veris Industries.
    d. Or approved equal.

2.012 SYSTEM OUTPUT CONTROLLED DEVICES

A. PILOT CONTROL RELAYS: Pilot Control relays shall provide either momentary or maintained switching action as appropriate for the application. Relay contact configuration, amp, voltage, and coil ratings shall be suitable for application. All panel mounted control relays shall:
    a. Be plugged in type with an interchangeable module (Ice Cube)
    b. Be mounted on a subbase and wired to numbered terminals strips.
    c. Be DPDT with indicating lamp.
2. Remotely mounted pilot control relays (outside of the panel) shall be enclosed in a NEMA enclosure suitable for the location. RIB style relays shall be acceptable for remote control.
3. All control relays shall be labeled with UR symbol and UL listed.
4. Acceptable Manufacturers:
    a. Functional Devices.
    b. Veris.
    c. IDEC.
    d. Or approved equal.

B. ACTUATORS, CONTROL DAMPER: The control damper actuator shall be sized for sufficient force to operate the damper under normal conditions and sized for torque required to guarantee tight close off of dampers, as specified. Two position control damper actuators shall provide auxiliary end-switch. Control damper actuators shall be electronic, 24 VAC or 120 VAC,

as selected by the Contractor and have internal electronic overload protection or digital rotation sensing circuitry. Modulating control damper actuators shall be controlled from a 2 to 10 VDC or 4 to 20 mA. VAV control damper actuators shall be "drive open; drive closed" type. Control damper actuators shall be selected for specified control (modulating or two position) and Fail Safe position, spring return mechanism, as specified.

1. Control damper actuator coupling shall be by a V bolt and V shaped; toothed cradle designed for minimum 60,000 full stroke cycles at rated torque. The control damper actuator run time for a commanded full stroke operation shall not exceed 120 seconds, if the actuator is spring returned, a return to the failsafe position shall take no longer than 10 seconds closed. Provide external, manual gear release on non-spring return actuators.
2. Control damper actuator casings shall be made of die cast metal.
3. Control damper actuators shall have position indication.
4. Control damper actuators exposed to low temperatures shall have a crankcase heater.
5. Control damper actuator enclosures shall be rated for the mounting environment
6. Pneumatic control damper actuators pilot positioners shall be installed to ensure positioning.
7. Control dampers actuators shall be selected for running torque calculated as follows:
    a. Parallel Blade Damper w/o Edge Seals: 4 inch-lb. /sq. ft. of damper.
    b. Parallel Blade Damper w/ Edge Seals: 7 inch-lb. /sq. ft. of damper.
    c. Opposed Blade Damper w/o Edge Seals: 3 inch-lb. /sq. ft. of damper.
    d. Opposed Blade Damper w/ Edge Seals: 5 inch-lb. /sq. ft. of damper.
    e. Additional damper actuator torque calculation per square foot damper surface area:
        1) Pressure Drop of 2 to 3 inch w.g.: Add 1.5 inch-lb
        2) Pressure Drop of between 3 to 4 inch w.g.: Add 2.0 inch-lb
        3) Face Velocities of 1000 to 2500 fpm: Add 1.5 inch-lb
        4) Face Velocities of 2500 to 3000 fpm: Add 2.0 inch-lb
8. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Belimo Aircontrols (USA), Inc.
    c. Or approved equal.

C. ACTUATORS, CONTROL VALVE

1. Actuator sizing: The control valve actuator shall be sized for sufficient force to operate the valve under all conditions and sized for torque required to guarantee tight close off of valves, as specified, against system differential pressure encountered. Two way control valve actuators shall provide a close off rating exceeding the maximum pressure difference between the valve outlet and inlet.
2. Power Requirements: Actuators shall be electronic, 24 VAC or 120 VAC, class 2 as directed by the application, and as selected by the Contractor. Actuators shall have internal electronic overload protection or digital rotation sensing circuitry. End switches to deactivate at the end of rotation or magnetic clutches are not acceptable. Power consumption shall not exceed 10 VA for AC.
3. Modulating Control Signal: Spring return actuators shall be capable of CW or CCW mounting orientation. Actuators shall be controlled from a 2 to 10 VDC or 4 to 20 mA. Actuators for VAV applications shall be "drive open; drive closed" type.
4. Noise Generation: Spring return actuators shall not produce more than 62 dbA when powered or positioning. Non-spring return actuators shall have a maximum noise rating of 45 dbA with power on or in the running or driving mode.
5. Fail Safe Operation: Spring return actuators shall be selected for modulating or two position, with a Fail Safe position, as specified. Spring return actuators shall upon a loss of control signal, fail to the minimum control signal. Non-spring return actuator shall maintain the last position upon loss of power. Control valve actuators using “on-board” capacitors or other non-mechanical forms of fail-safe operation are unacceptable.
6. Coupling: Control valve actuators shall be of a Direct coupled type designed for minimum 60,000 full stroke cycles at rated torque.
7. Operation Time: The run time for full stroke operation shall not exceed 120 seconds. Spring return to the failsafe position shall take no longer than 10 seconds closed. Non-spring return actuators greater than 60 in-lb of torque shall have a local external, manual gear release.
8. Construction: Control valve actuator casings shall be made of die cast metal.
9. Position Indication: Actuators on valves larger than 2 inch shall have a visual position indication. When required by the control sequence, two sets of DPDT switches with fully adjustable setpoints shall be provided.

10. Environment Rating: Actuator enclosures shall be rated for the mounting environment. Actuators shall have an operating range of minus 22 to 122 degrees F. Actuators exposed to low temperatures shall have a crankcase heater.
11. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Belimo Aircontrols (USA), Inc.
    c. Or approved equal.

2.013 FIELD DEVICES

A. CONTROL POWER TRANSFORMERS & POWER SUPPLIES: Control power transformers shall be UL listed, Class 2 current limiting type, or shall be furnished with over current protection with primary and secondary circuits for Class 2 service. Unit power output shall match the required output current and voltage requirements. Current output shall allow for a 50 percent safety factor. Output ripple shall be 3.0 mV maximum Peak to Peak. Regulation shall be 0 to 10 percent line and load combined, with 50 microsecond response time for 50 percent load changes. Unit shall have built in over voltage protection. Unit shall operate between 32 to 120 degrees F. Unit shall be UL recognized.

1. Acceptable Manufacturers:
    a. Honeywell Controls.
    b. Functional Devices.
    c. Or approved equal.

B. CONTROL VALVES: Control valves shall be factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. The control valve nominal body rating shall be not less than 125 PSI. Control valve body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule in this Specification. The control valves shall be sized by the Contractor to produce the required flow capacity at a pressure loss not exceeding the allowable pressure drop. The control valve body and packing selected shall be sized to withstand the system static head plus the pump head, and the temperatures of the control medium. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Flow Characteristics: Two way valves shall have equal

percentage characteristics; Three way valves shall have linear characteristics. Connections: Control valve sizes up to, including 2 inch shall be "screwed" configuration. Control valve sizes 2 1/2 inch and larger shall be "flanged" configuration.

1. Control Valve Selection and Sizing Guidelines: 2-way or 3-way control valves serving Variable Air Equipment coils, shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. 3-way control valves serving Constant Air Equipment coils, with secondary loop pumps shall be sized for a pressure drop equal to 25 percent of the actual coil pressure drop, but no less than 2 PSI. 3-way mixing control valves serving secondary water loops shall be sized for a pressure drop of no less than 5 PSI. All control valve sizes less than 2 inches shall be globe valves. Control valves for terminal reheat coils shall be sized for no less than a 2 PSIG pressure drop, but no more than a 5 PSI drop.
2. Ball Valves (w/characterized disk): shall be used for hot and chilled water applications, water terminal reheats coils, radiant panels, unit heaters, package air conditioning units, and fan coil units. Hot water control valves shall fail Normally Open to the coil. Chilled water control valves shall be fail Normally Closed to the coil. Steam control valves shall fail Normally Closed to the coil or as stated in the sequences.
3. Modulating plug valves: Single seat type Equal percentage shall be used for approved applications. Valve discs shall be composition type. Valve stems shall be stainless steel.
4. Acceptable Manufacturers:
    a. Honeywell, Belimo Controls (USA), Inc.
    b. Or approved equal.

C. LOCAL CONTROL ENCLOSURES AND PANELS:

1. All enclosures shall be rated for the mounted environment. Unless otherwise shown, all indoor control enclosure cabinets shall be fully enclosed NEMA 1 steel construction, with a baked enamel finish. A hinged door key lock latch and removable sub panels shall be provided for non-unitary equipment. A single key shall be common to all field panels and sub panels.
2. Interconnections between internal and face mounted devices shall be prewired with color coded stranded conductors neatly installed in plastic troughs and/or tie wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock Drawings, with adequate clearance for field wiring.

Control terminations for field connection shall be individually identified per control Drawings.

3. Provide ON/OFF power switch with over current protection for control power sources to each local panel.
4. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.
5. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts.
6. All control panels shall be UL inspected and listed as an assembly and carries a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
7. In general, the control panels shall consist of the BACnet DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
8. All I/O connections on the BACnet DDC controller shall be provide via removable or fixed screw terminals.
9. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed 300 volt service and provide adequate clearance for field wiring.
10. All wiring shall be neatly installed in plastic trays or tie wrapped.
11. Control Panels shall be rated for the environment in which they are located.
12. Acceptable manufacturers
    a. Honeywell Controls.
    b. Or approved equal.

D. BMS CONTROL CABLING

1. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16 unless otherwise noted herein. All insulated wire to be copper conductors, UL labeled for 90 degrees C minimum service. Electronic and fiber optic cables for control wiring are specified in Electrical Section "Voice and Data Communication Cabling."

2. Communication and Control Wiring: Wire Sizing and Insulation shall comply with minimum wire size and insulation based on services listed below:

	Service	Minimum Gage/Type	Insulation Class
a.	AC 24 VAC	Power 12 Ga Solid	600 Volt
b.	DC 24 VDC	Power 10 Ga Solid	600 Volt
c.	Class 1	14 Ga Stranded	600 Volt
d.	Class 2	18 Ga Stranded	300 Volt
e.	Class 3	18 Ga Stranded	300 Volt

f. Open plenum rated cable is permitted in supply or return air plenum where allowed.

4. Power Wiring:
   a. 115 VAC power circuit wiring > 100 feet distance shall use minimum 10 gage.
   b. 24 VAC control power wiring > 200 feet distance shall use minimum 12 gage.
5. Control Wiring:
   a. Digital Input/Output wiring shall use Class 2 twisted pair, insulated.
   b. Analog inputs shall use Class 2 twisted shielded pair, insulated, and jacketed and require a grounded shield.
6. Communication Wiring:
   a. Ethernet Cable shall be minimum CAT5e minimum
   b. Secondary level network shall be 24 gage, TSP, low capacitance cable
7. Approved Cable Manufacturers:
   a. Anixter.
   b. Belden.
   c. Or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.02 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards or tamper proof enclosures on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Division 15 Section "Duct Accessories.

G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 15 Section "Basic Mechanical Materials and Methods."

I. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

J. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

K. Install steam and condensate instrument wells, valves, and other accessories according to Division 15 Section "Steam and Condensate Piping."

L. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

M. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

N. Install electronic and fiber-optic cables according to Division 16 Section "Control/Signal Transmission Media."

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

B. Install building wire and cable according to Division 16 Section "Conductors and Cables."

C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. 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.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
3. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.
2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

C. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify operation of operator workstation.
3. Verify local control units including self-diagnostics.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.
3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.07 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.08 TRAINING

A. Provide a minimum of 24 hours of on-site or classroom training throughout the Contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:

1. Proficiently operate the 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 the workstation and peripherals
6. Log on and off the system
7. Access graphics, point reports, and logs
8. Adjust and change system set points, time schedules, and holiday schedules
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
10. Understand system Drawings, and Operation and Maintenance manual
11. Understand the job layout and location of control components
12. Access data from DDC controllers
13. Operate portable operator's terminals

END OF SECTION 15900

SECTION 15940 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings & general provisions of the Contract, including General and Supplementary Conditions & Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. See Division 15 Section "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

C. Reference the BAS diagrams for Unit configuration, BAS devices, point types & locations

1.03 DEFINITIONS & ABBREVIATIONS

A. Analog: A continuously variable system or value not having discrete levels.

B. Binary: A two-state condition, i.e. “ON” or “OFF”.

C. Floating: A timed spanned signal using a binary input/output to operate a variable positioned actuator.

D. Automatic Temperature Control System: The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the associated Work of other related trades.

E. BAS Contractor (BAS): The single Contractor to provide the Work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BAS Work.

F. Control Sequence: A pre-programmed arrangement of software algorithms, logical computation, target values and limits as required attaining the defined operational control objectives.

G. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative & Integral control algorithms together with

target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

H. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS Work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Division.

J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

K. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BAS Contractor’s cost to the designated third party trade Contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.

L. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

M. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.

N. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.

O. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.

P. Singular usage: The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

Q. Interpretation Aids: Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

R. The following abbreviations and acronyms may be used in describing the Work of this Division, Additional acronyms shall be declared throughout the Specifications:

1. Organization and Project entities

   a. ASHRAE - American Society of Heating, Refrig. & Air Cond. Engineers
   b. BAS - Division 15 Building Automation System Contractor
   c. EC - Division 16 Electrical Contractor
   d. GC - General Contractor
   e. IEEE - Institute of Electrical and Electronics Engineers
   f. MC - Division 15 Mechanical Contractor
   g. SM - Division 15 Sheet Metal Contractor
   h. UM - Unit Manufacturer, Equipment

2. Direct Digital Controls Abbreviations

   a. ANALOG - A variable signal (4-20mA, 2-10VDC etc.)
   b. BINARY - A 2 state signal (On/Off, Open/Closed etc.)
   c. FLOATING - A timed digital signal
   d. AI / AO - Analog Input / Analog Output
   e. CI / CO - Configurable Input / Configurable Output
   f. DI / DO - Digital Input / Digital Output
   g. DDC - Direct Digital Control
   h. I/O - Input/Output point
   i. LOOP- A control algorithm, with an analog input and output
   j. PID - Proportional, Integral, Derivative
   k. NO / NC - Normally Open / Normally Closed
   l. SR/NSR - Spring Returned / Non-Spring Returned

3. Computer or Electronics

   a. CPU - Central Processing Unit
   b. EEPROM - Electronically Erasable Programmable Read Only Memory
   c. GUI - Graphical User Interface
   d. LAN/WAN - Local Area Network/Wide Area Network
   e. PC/OWS - Personal Computer/Operator Workstation
   f. RAM / ROM - Random Access Memory / Read Only Memory
   g. TCP/IP - Transmission Control Protocol/Internet Protocol
   h. UPS - Uninterruptible Power Supply

4. Cooling Plant Abbreviations

   a. CHWP - Chilled Water Pump, Primary (P-), Secondary (S-)
   b. CHWS/R - Chilled Water Supply/Return
   c. CH/ACCH - Chiller, Water or Air Cooled

5. Heating Plant Abbreviations

   a. B or BLR - Boiler, Hot Water or Low Pressure Steam
   b. BHWP - Boiler Hot Water Pump, Inline
   c. HWP - Hot Water Pump, Primary (P-), Secondary (S-)
   d. HWS/R - Hot Water Supply/Return

e. MER - Mechanical Equipment Room

6. Primary HVAC Equipment Abbreviations

a. ERU / ERV - Energy Recovery Unit / Energy Recovery Ventilator
b. BCU / FCU - Blower Coil Unit / Fan Coil Unit
c. MAU - Makeup Air Unit
d. RTU - Roof Top Unit

7. Ancillary HVAC Equipment Abbreviations

a. EDH - Electric Duct Heater
b. EF - Exhaust Fan
c. FP/VAV - Fan Powered/Variable Air Volume
d. HP - Heat Pump
e. CAV/VAV - Constant Air Volume Box / Variable Air Volume Box

8. Field Devices Abbreviations

a. AQ - Thermostat, pipe mounted SPDT
b. CT/CS - Current transducer/ Current Switch
c. F/SD - Fire/Smoke Damper
d. FAS/FACP - Fire Alarm Detection System/Fire Alarm Control Panel
e. HOA - Hand-Off-Auto
f. LPS/HPS - Low Pressure Switch / High Pressure Switch
g. ES - End-Switch
h. LDS - Liquid Detection Switch
i. LCD / LED - Liquid Crystal Display / Light Emitting Diode
j. LLS - Low Limit Temperature Switch, (SPST) or (SPDT)
k. LWCO - Low Water Cutout switch
l. MD - Actuator Operated Damper
m. MS / VFD - Motor Starter / Variable Frequency Drive
n. OCC - Occupancy Sensor
o. PDT - Pressure Differential Transducer
p. PDS - Pressure Differential Switch
q. R - Control Pilot Relay
r. SD - Smoke Detector or Smoke Damper
s. SPDT / SPST - Single Pole Double Throw / Single Pole Single Throw
t. SW - Switch
u. T/TS - Temperature / Temperature Sensor
v. TC - Thermostat switch
w. 2W/3W - 2-Way or 3-way
x. CV - Constant Air Volume or Flow Coefficient of a Control Valve
y. SCV - Self-contained control valve
z. V - Valve, Temperature Control

9. Power and Energy Abbreviations

a. AWG - American Wire Gauge

b. KW/KWH - Kilo-Watts (Power)/ Kilo-Watt-Hours
c. mA - milli-ampere
d. VA - Voltage-Ampere
e. VAC/VDC - Volts, Alternating Current / Volts, Direct Current

10. Project delineation and information Abbreviations

a. NIC / FBO - Not In Contract / Furnished by Others
b. TBA/TBD - To Be Advised / To Be Determined

11. Control Media Abbreviations

a. SAT/SAH - Supply Air Temperature/ Supply Air Temperature
b. DAT/DAH- Discharge Air Temperature/ Discharge Air Temperature
c. MAT - Mixed Air Temperature
d. RAT/RAH - Return Air Temperature/Return Air Humidity
e. OAT/OAH - Outdoor Air Temperature / Outdoor Air Humidity
f. RH - Relative Humidity
g. CO/CO2 - Carbon Monoxide / Carbon Dioxide

1.04 COORDINATED SEQUENCES & BAS DIAGRAMS

A. Project BAS Diagrams

1. The Sequences of Operations detailed below are predicated on the specific Project BAS diagrams.
2. Reference the BAS Diagrams for the Unit configuration, BAS control devices, point types & locations for each device.

B. Control Sequence Descriptions:

1. The control sequences below describe all necessary equipment operation including those operations that are provided by the HVAC Equipment Unit manufacturers (UM) & those as part of the Automatic Temperature Controls system (BAS).

1.05 RESPONSIBILITIES

A. Automatic Temperature Control (BAS) Contractor's Responsibilities:

1. The BAS Contractor (BAS) shall provide, field install & wire all necessary software & hardware, wiring, & computing equipment in compliance with this Specification. The BAS Contractor shall also provide programming, interface design, startup services by competent technicians that regularly employed by the BAS Contractor with full responsibility for proper operation of the control system including debugging & proper calibration of each component in the entire system
2. The BAS Contractor (BAS) shall provide power supply wiring to all external control panels, actuators (valves, dampers, etc.), including low voltage transformers, including

the power for devices required for operation of BACnet communication as provided as part of complete HVAC Equipment Unit Manufacturer provided BACnet packaged.

B. Mechanical Contractors (MC) Responsibilities:

1. The Mechanical Contractor (MC) shall provide coordination between the HVAC Equipment Unit Manufacturers (UM) & the BAS Contractor (BAS) to provide a fully coordinated & operational Automatic Temperature Controls system

a. Refer to this & the specific equipment Specifications & schedules for devices provided, installed & wired by the HVAC equipment Unit manufacturers (UM) & those by the BAS contactor (BAS).

C. HVAC Equipment Unit Manufacturer (UM) Responsibilities

1. The HVAC Equipment Unit Manufacturer (UM) shall provide the equipment and field start-up & commissioning labor to meet the sequence requirements of this Specification & schedules sections.
2. The HVAC Equipment Unit Manufacturer (UM) shall provide factory installation & wiring of the BAS provided controls, when specified to be factory installed
3. The HVAC Equipment Unit Manufacturer (UM) shall provide BACnet controller wiring details for the UM provided controls at time of award to allow BAS Contractor to complete submittal Drawings.

1.06 OPERATOR INTERFACE REQUIREMENTS

A. The BMS Control Diagrams and the tables below shall provide for Operator Control of the HVAC equipment through an accurate depiction of the device(s) within the unit, along with the I/O points, parameters and alarms shall be displayed on a customized 3-dimensional web-based graphic.

1.07 SYSTEM TRENDS

A. DATA COLLECTION: Unless noted otherwise, the BMS shall record the Analog Trend data samples every 5 minutes. Binary Trends shall record data samples every Change of Value (COV).

1.08 SUPREVISORY NETWORK CONTROLLER (SNC):

A. COORDINATION: The BMSC shall provide an additional SNC network controller with the specificied capacity. This shall include new graphics and programs; integrate all of the new DDC equipment to the existing BMS network.

B. COMMUNICATIONS OFFLINE ALARM (COMM): Anytime communication is lost to a BMS DDC Controller a Communication Lost Alarm (COMM) shall be sent to the GUI.
1. Alarms

Supervisory Network Controller	Alarms and Conditions		
Alarm Name	Point	Normal	Alarm
BACnet Interface Alarms			
Communications Offline Alarm	Comm		

1.09 EXHAUST FAN (EF)

A. COORDINATION: The BMSC shall provide, install, and wire a control device(s) including a control relay (EFSS) and current sensor (EFST). The Unit shall be provided as outlined under the equipment schedules. The Division 16 Electrical contractor (DIV16) shall provide all line voltage wiring.

B. SCHEDULING: The Unit's operation shall be hard-wired interlocked with the associated equipment schedule.

C. "RUN INHIBIT": The Exhaust Fan (EFSS) shall be commanded to "stop" during "Unoccupied" and "Warm-up" sequences of operations.

D. "OCCUPIED": When the associated HVAC Equipment is scheduled (SCHED) to "Occupied", the Exhaust Fan (EFSS) shall be commanded to "start"

E. "PROOF OF OPERATION": A current switch shall monitor the Exhaust Fan status (EFST).

F. FAN FAILURE ALARM (FAIL): If the Exhaust Fan (EFSS) is commanded to "start", but the Exhaust Fan status (EFST) is "off", a Fan Failure (FAIL) alarm shall be sent to the GUI.

G. FAN IN HAND ALARM (HAND): If the Exhaust Fan (EFSS) is commanded to "stop", but the Exhaust Fan status (EFST) is "on", a Fan-in-Hand (HAND) alarm shall be sent to the GUI.

H. OPERATOR INTERFACE REQUIREMENTS:

1. Input/Output Points:

Exhaust Fan – Interlocked	**I/O Points**						
Point Name/Description/Legend X = DDC I/O L = Local Control A = Adjustable O = Override	AI	AO	BI	BO	Trend	GUI	Device
Exhaust Fan Start/Stop (EFSS)				O	X	X	R
Exhaust Fan Status (EFST)			X		X	X	CS

2. Control Parameters and Settings

Exhaust Fan – Interlocked	Parameters and Settings			
Parameter Name/Description X = Display on GUI A = Adjustable	AV	Trend	GUI	Initial-Setting
Occupancy Schedules (SCHED)	X	X	X	
All Alarm Setpoints and/or Parameters	A	X	C	Alarm settings
Alarm Reset	A	X	X	

3. Alarms

Exhaust Fan – Interlocked	Alarms and Conditions		
Alarm Name	Point	Normal	Alarm
Fan Failure (FAIL)	EFSS EFST	EFSS = ON EFST = ON	EFSS = ON EFST = OFF
Fan in Hand (HAND)	EFSS EFST	EFSS = OFF EFST = OFF	EFSS = OFF EFST = ON

1.010 FAN COIL UNIT

A. COORDINATION: The BMSC shall provide, field install and wire a B-ASC DDC controller, sensor(s), relays, control valves and all necessary equipment required to meet the control sequence requirements. Additionally, the BMSC shall provide the field interlock wiring to associated controlled equipment. The Unit's shall be provided as outlined under the equipment schedules. The MC shall provide coordination between the OEM and BMSC for a complete functional system.

B. SCHEDULING: The Unit's schedule is as established in the GUI and shall be communicated to the Unit's DDC controller. The unit's DDC controller shall have a built-in timeclock.

C. SCHEDULE OVERRIDE : A schedule Override on the Space Temperature Sensor (RMT) shall override the schedule (SCHED) when the button is depressed. An LED shall indicate that the Unit is overridden into the "Occupied" mode for up to 3 hours (adj.). The Unit shall revert to its scheduled (SCHED) upon the time expiration of the override or upon further depression of the button.

D. SPACE TEMPERATURE SENSOR (RMT): The Space Temperature Sensor(s) (RMT) shall have an LCD screen depicting the Temperature (RMT) and Setpoints (CSP/HSP).

E. SPACE TEMPERATURE / RELATIVE HUMIDITY SENSOR (RMT/RMRH): The Space Temperature / Humidity Sensor(s) (RMT/RMRH) shall have an LCD screen depicting the Temperature (RMT), Temperature Setpoints (CSP/HSP) and Relative Humidity (RMRH). Space Temperature Sensor(s) (RMT) in public areas shall have a blank vented stainless steel design. The Space Heating (HSP/UHSP) and Cooling (CSP/UCSP) shall be controlled from the GUI.

F. SPACE TEMPERATURE SETPOINTS: The setpoints shall initially be 72 °F (adj.) for heating (HSP) and 74 °F (adj.) for cooling (CSP) with a setpoint adjustment span setting of ± 4 °F (adj.).

G. "PROOF OF OPERATION": A current switch shall monitor the Unit's Supply fan status (SFST). The unit shall remain in the "Unoccupied" mode until the Supply Fan status (SFST) indicates "on".

H. MODE INHIBIT: During the any cooling mode all heating modes shall be disabled. During the any heating mode all cooling modes shall be disabled.

I. "UNOCCUPIED": When the Unit is scheduled (SCHED) to "Unoccupied", the Unit's Fan (FSS) shall be commanded to "stop". Any associated Exhaust Fan(s) (EFSS) shall be commanded to

"stop"; the Outside Air damper(s) (OAD) shall be commanded to "close";, the Direct eXpansion Cooling stages (DX) and Electric Duct Heater (HTG) shall be commanded "off".

J. "OCCUPIED": When the Unit is scheduled to "Occupied", the Unit's fan (FSS) shall be commanded to "start"; the Outside Damper (OAD) shall be commanded to "open". Any associated Exhaust Fan (EFSS) shall be commanded to "start".

K. "INTAKE AIR HEATING": When the Intake Air Temperature is less than the "Local Heating" Setpoint the Intake Air Heating Coil control (HTG) shall cycle "on". When the Intake Air Temperature is greater than the "Local Heating" Setpoint hysteresis, the Intake Air Heating Coil control (HTG) shall cycle "off".

L. "COOLING": When the Space Temperature (RMT) is greater than the scheduled "Cooling" Setpoint (CSP)(UCSP), the Unit's Fan (FSS) shall be commanded to "start"; the Heating Coil (HTG) shall be commanded to "off".; When the current switch on the Unit's Fan Current Switch (FST) indicates "on", the Direct eXpansion Cooling stage(s) (CLG) shall be sequenced "on". When the Space Temperature (RMT) is less than the "Cooling" Setpoint (CSP)(UCSP) hysteresis, the Direct eXpansion Cooling stages (CLG) shall be sequenced "off". The Unit's Fan (FSS) amd Heating Coil control (HTG) shall revert back to the scheduled sequence. The owner shall have the ability to disable this feature via software.

M. FILTER MAINTENANCE (FILTER): The Unit's Supply fan status (SFST) shall be monitored and shall provide a maintenance reminder (FILTER) at the GUI when the Filter Replacement Timer Setting (FILTERSP) has been reached. A software reset shall be required to silence/reset the timer function.

N. SPACE TEMPERATURE (TEMP) ALARM: If the Space Temperature (RMT) is greater than 4°F (adj.) from the scheduled setpoints. A Space Temperature Alarm (TEMP) shall be sent to the GUI.

O. LIQUID DETECTION SENSOR (LIQUID) ALARM: A Liquid Detection Sensor (LDS) switch shall be located to detect accumulated liquids in the Drip Pan. Upon detection of a liquid the Unit's Supply Fan (SFSS) shall be commanded to "stop"; the Outside Air damper (OAD) shall be commanded to "close"; the Return Air damper (RAD) commanded "open".; The unit's cooling sequences shall be disabled. The Heating Coil control valve (HTG) shall be commanded "open" to the coil. A Drip Pan Liquid Detection (LIQUID) alarm shall be sent to the GUI. The alarm shall be reset through a software switch from the GUI.

P. COOLING FAILURE ALARM (COOLFAIL): If the Discharge Air Temperature (DAT) remains within 4°F (adj.) of the Space Temperature (RMT) after with the mechanical cooling is utilized (for greater than 5 minutes). A Cooling Failure (COOLFAIL) alarm shall be sent to the GUI. This alarm shall not be enabled until the Supply Fan status (SFST) has been "on" for 10 minutes (adj.).

Q. FAN FAILURE ALARM (FAIL): If the Supply Fan command (SFSS) is commanded to "start", but the Supply Fan status (SFST) is "off", a Fan Failure (FAIL) alarm shall be sent to the GUI.

R. FAN IN HAND ALARM (HAND): If the Supply Fan command (SFSS) is commanded to “stop”, but the Supply Fan status (SFST) is “on”, a Fan-in-Hand (HAND) alarm shall be sent to the GUI.

S. CARBON-DIOXIDE ALARM (DCV): When the Unit’s Supply Fan (SFSS) is commanded to “start”, and the Carbon-Dioxide level (CO2) remains above 1100 ppm (adj.) for more than 1 hour, or if the Carbon-Dioxide level (CO2) levels exceed 1400 ppm. A Demand Control Ventilation (DCV) alarm shall be sent to the GUI.

T. TEMPERATURE SENSOR FAILURE (SENSOR): Anytime the value of a Temperature Sensor is greater or less than the operational limitations of the sensor, and Temperature Sensor Failure (SENSOR) alarm shall be sent to the GUI.

U. OPERATOR INTERFACE REQUIREMENTS:

1. Input/Output Points:

Fan Coil Unit	**I/O Points**						
Point Name/Description/Legend X = DDC I/O L = Local Control A = Adjustable O = Override	AI	AO	BI	BO	Trend	GUI	Device
Fan Start/Stop (FSS)				O	X	X	R
Fan Status (FST)			X		X	X	CS
Direct eXpansion Cooling (CLG)		O		O	X	X	
Heating Coil control (HTG)		O		O	X	X	
Space Temperature (RMT)	X				X	X	TS-W
Space Relative Humidity (RMRH)	X				X	X	RH-W
Space Carbon-Dioxide level (RMCO2)	X				X	X	CO2-W
Discharge Air Temperature (DAT)	X				X	X	TS-D
Outside Air Damper (OAD)				X	X	X	M
Filter (FLTR)			X		X	X	DPS
Liquid Detection Sensor (LDS)			X		X	X	LDS

2. Control Parameters and Settings

Fan Coil Unit	**Parameters and Settings**			
Parameter Name/Description X = Display on GUI A = Adjustable	AV	Trend	GUI	Initial- Setting
Occupancy Schedules (SCHED)	X	X	X	
“Occupied” Space Heating Setpoint (HSP)	A	X	X	70 °F
“Occupied” Space Cooling Setpoint (CSP)	A	X	X	72 °F
“Unoccupied” Space Heating Setpoint (UHSP)	A	X	X	65 °F
“Unoccupied” Space Cooling Setpoint (UCSP)	A	X	X	78 °F
Relative Humidity Setpoint (RHSP)	A	X	X	50 %r.h.
Filter Replacement Timer (FILTERSP)				1000 hours
All Alarm Setpoints and/or Parameters	A	X	C	Alarm settings
Alarm Reset	A	X	X	

3. Alarms

Fan Coil Unit / Unit Ventilator	**Alarms and Conditions**		
Alarm Name	Point	Normal	Alarm

Filter Maintenance	FLTR	OFF	ON
Space Temperature (TEMP)	RMT	< +/- 4°F SP	> +/-4°F SP
High Humidity (HUMIDITY)	RMRH	<10%r.h. SP	>10%r.h. SP
Liquid Detection Sensor (LIQUID)	LDS	OFF	ON
Cooling Failure (COOLFAIL)	See Sequence of Operations		
Heating Failure (HEATFAIL)	See Sequence of Operations		
Fan Failure (FAIL)	#FSS #FSTS	#FSS = ON #FST = ON	#FSS = ON #FST = OFF
Fan in Hand (HAND)	#FSS #FSt	#FSS = OFF #FST = OFF	#FSS = OFF #FST = ON
High CO2 (DCV)			> 1100 ppm 1 hour
Temp Sensor Failure (SENSOR)	Varies	-10°F < Input Input < 220°F	-10°F > Input Input > 220°F

1.011 OUTSIDE AIR INTAKES (OAI)

A. COORDINATION: The BMSC shall provide damper actuators, and all necessary equipment required to meet this specification and mechanical system control sequence requirements.

B. SCHEDULING: A motorized damper shall “open”/”Close” the OAI as scheduled from the interlocked BACnet DDC controller.

1.012 CONDENSATE PUMPS

A. The ATC contractor (ATC) shall provide a Control Relay (R), Low Leak Detector & a Current Switch (CS) to monitor the status of the Condensate Pump. An alarm shall be generated when either the status of the pump does not meet the commanded sequence after 30 seconds or when the Low Leak Detector Alarm is activated.

1. The Condensate Pump shall be energized when there is a detection of a leak in the condensate drain pain.

2. A Low Leak Detector Switch shall activate an alarm if energized.

B. Operator & Graphical User Interface requirements

1. The ATC Control Diagrams & the table below shall provide for Operator Control of the HVAC equipment:

Condensate Pump	I/O Points				Software Point						
Point Name/Description/Legend X = DDC I/O L=Local Control A = Adjustable O = Override	AI	AO	BI	BO	AV	BV	Sched-ule	Trend	Alarm	GUI	Initial-Alarm Setting
Condensate Pump Status (CPS)			X						X	X	
Low Leak Detector Status (LLDS)			X						X	X	

1.013 OUTSIDE AIR CONDITIONS

A. COORDINATION: The BMSC shall provide, install, and wire an Outside Air sensor(s) with weather and sunshields on a northern exposure of the building.

B. SENSOR FAILURE (SENSOR): Anytime the value of a Sensor is greater or less than the operational limitations of the sensor, a Sensor Failure alarm (SENSOR) shall be sent to the GUI.

C. OPERATOR INTERFACE REQUIREMENTS:

1. Input/Output Points:

Outside Air Conditions	**I/O Points**						
Point Name/Description/Legend X = DDC I/O L = Local Control A = Adjustable O = Override	AI	AO	BI	BO	Trend	GUI	Device
Outside Air Temperature (OAT)	X				X	X	TS-O
Outside Air Humidity (OARH)	X				X	X	RH-O
Outside Air CO2 (OACO2)	X				X	X	CO2-O

2. Control Parameters and Settings

Outside Air Conditions	**Parameters and Settings**			
Parameter Name/Description X = Display on GUI A = Adjustable	AV	Trend	GUI	Initial- Setting
Calculated Degree Day – Heating	X	X	X	
Calculated Degree Day – Cooling	X	X	X	
Highest Value (Past 24 hours)	X	X	X	
Lowest Value (Past 24 hours)	X	X	X	
All Alarm Setpoints and/or Parameters	A	X	C	Alarm settings
Alarm Reset	A	X	X	

3. Alarms

Outside Air Conditions	**Alarms and Conditions**		
Alarm Name	Point	Normal	Alarm
Temp Sensor Failure (SENSOR)	Varies	Sensor Out of Operational Range	

1.014 SYSTEM STARTUP

A. The BMSC shall provide BMS factory trained and certified technicians to setup, check and adjust the BMS device(s) utilized on the project. The BMS technicians shall be experienced in the type of HVAC systems associated with this project.

1.015 GRAPHICAL USER INTERFACE (GUI)

A. WEB-CLIENT WORKSTATION: The BMSC shall provide a TCP/IP connected Workstation with the ability to read, adjust and override the various parameters for system control; provide each of the DDC controlled equipment with graphics with a minimum of the complete I/O point listing,

their associated setpoints and any other variable for the adjustment and operation of the system.

1.016 SYSTEM DEMONSTRATION:

A. After the startup has been completed on the BMS, the BMSC shall provide a thorough demonstration of the Sequence of Operation for each BMS controlled system(s) to the Architect or their Representative.

1.017 GRAPHICAL USER INTERFACE (GUI) DEMONSTRATION:

A. COORDINATION:
   1. BMSC shall demonstrate the Graphics, trending, and communications setup to the Owner prior to acceptance of the system.

B. ALARM NOTIFICATION:
   1. The BMS shall notify the Owner of an alarming condition via a Visual Alerts and Audible sounds locally at the GUI.
   2. If connected via a TCP/IP connection, an e-mail sent depending on user configuration.
   3. Any maintenance worker shall be capable of interrogating the alarm using the Laptop workstation browsers (via. the internet)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15940

SECTION 15950 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Variable-flow hydronic systems.
b. Primary-secondary hydronic systems.

1.03 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.

1.04 SUBMITTALS

A. Qualification Data: 30 days of Contractor's Notice to Proceed, submit documentation that the TAB Subcontractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Bid Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Bid 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. Certified TAB reports.

E. Sample report forms.

F. 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.

1.05 QUALITY ASSURANCE

A. TAB Subcontractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB Subcontractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB Subcontractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Architect or Owner on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Bid Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and Subcontractors.
d. Coordination of documentation and communication flow.

C. 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.

D. TAB Report Forms: Use standard TAB Subcontractor's forms approved by Architect or Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.06 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.07 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 and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB Subcontractors that may be engaged include, but are not limited to, the following:

1. USC Environmental Inc.

2. Or Approved Equal.

3.02 EXAMINATION

A. Examine the Bid 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 used for return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 15 Section "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.

3.03 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. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

C. Review all Bid Documents existing conditions, and as-built conditions pertaining to the HVAC systems.

D. Mechanical Subcontractor shall provide all equipment, material, parts, supplies, and labor to balance all HVAC equipment to Owner’s satisfaction.

3.04 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" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, 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 Division 15 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Sections for Ductwork and Piping 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 units.

3.05 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 Division 15 Section "Metal Ducts."

3.06 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. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

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 or Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Section 15725, "Modular Air Handling Units Indoor" 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 within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Bid Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.08 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.09 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner and comply with requirements in Division 15 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.010 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.011 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.012 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.

3.013 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.014 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.015 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. 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.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.

4. Inlet steam pressure.

D. 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.

3.016 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 air flow 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.

3.017 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.
3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.018 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Bid 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 monthly 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.

3.019 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. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. 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 Subcontractor.
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 Bid 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 and hydronic 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. 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.

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. 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. 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.
o. Inlet steam pressure in psig.

G. Gas-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 air flow 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.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Air flow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. 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.

J. 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.

K. 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.

L. System-Coil Reports: For reheat coils 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. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.

e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

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.

3.020 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Bid Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner, Construction Manager, or Commissioning Authority.
2. The TAB Subcontractor's test and balance Engineer shall conduct the inspection in the presence of Owner or Construction Manager.
3. Owner or Construction Manager 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.

4. 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."
5. 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.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. 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 Subcontractor to complete TAB Work according to the Bid Documents and deduct the cost of the services from the original TAB Subcontractor's final payment.

D. Prepare test and inspection reports.

3.021 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 15950

PART 6 - ELECTRICAL

SECTION 13852 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Existing fire-alarm control panel.
   2. Manual fire-alarm boxes.
   3. System smoke detectors.
   4. System carbon monoxide detectors
   5. Heat detectors.
   6. Notification appliances.
   7. Device guards.
   8. Magnetic door holders.
   9. Remote annunciator.
   10. Addressable interface device.
   11. Digital alarm communicator transmitter.
   12. Radio alarm transmitter.
   13. System printer.

1.03 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.

12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances, smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.

2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.07 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. Smoke Detectors, Fire Detectors: Five of each type installed.
   2. Detector Bases: Five of each type installed.
   3. Keys and Tools: One extra set for access to locked or tamper proofed components.
   4. Audible and Visual Notification Appliances: Five of each type installed.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.09 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting Work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

   1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
   2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.010 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN

SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Existing system shall be existing to remain. Provide expander panels or modules as required to accommodate the work of this project..

C. Provide fire watch as required by local Authority Having Jurisdiction for areas not covered by Fire Alarm system.

D. Equipment Removal: After acceptance of new fire-alarm devices and equipment, remove existing disconnected fire-alarm devices and wiring.

1.011 WARRANTY

A. Warranty: System provider agrees to repair or replace fire-alarm system equipment and components including but not limited to the fire alarm control panel, detection devices, and notification devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.012 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include one (1) year full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

   1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. 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.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Smoke beam detector.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
9. Recall elevators to primary or alternate recall floors.
10. Activate elevator power shunt trip.
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.
14. Record events by the system printer.
15. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Alert and Action signals of air-sampling detector system.
2. Independent fire-detection and -suppression systems.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.

4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.03 FIRE-ALARM CONTROL PANEL

A. The fire alarm control panel is an existing Edwards EST-3 System. The Contractor shall provide new devices, booster panels, and expansion modules as required for a complete and operational installation.

B. All new equipment and devices shall be UL listed and compatible with the existing fire alarm system.

2.04 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed

B. outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

5. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.05 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
7. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.06 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

B. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.07 MULTICRITERIA DETECTORS

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

G. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.08 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or 195 deg F or as indicated on Drawings, or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.09 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall or ceiling mounted as shown on the plans.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished red for walls, white for ceilings, unless otherwise directed by the Architect.

D. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.010 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.011 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.012 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.

E. In addition to devices shown on the Bid Drawings, provide additional quantity of devices as specified on the fire alarm riser diagram. Include wiring, testing and programming, location as directed by the Engineer or local fire marshal.

2.013 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a

C. local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station ov

D. er the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

E. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

F. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

G. Secondary Power: Integral rechargeable battery and automatic charger.

H. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.014 SYSTEM PRINTER

A. Printer shall be listed and labeled as an integral part of fire-alarm system.

2.015 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, audible / visual signals, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control and/or monitoring equipment as necessary to extend existing control and/or monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and audible devices on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm audible device and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.03 PATHWAYS

A. Pathways shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.04 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an

addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to activate emergency lighting control.
5. Data communication circuits for connection to mass notification system.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.06 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.07 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by The Engineer and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system for a minimum of two days of training.

END OF SECTION 13852

SECTION 16051 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 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.

1.03 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For sleeve seals.

1.05 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 sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through Penetration Firestop Systems".

PART 2 - PRODUCTS

2.01 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. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter, less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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 cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic. 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.

2.03 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

3.01 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.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, or wireways or masonry walls, or fire-rated floor and wall assemblies.

B. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

C. 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.

D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Extend sleeves installed in floors 2 inches above finished floor level.

F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

G. 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.

H. 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."

I. 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."

3.03 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.

3.04 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 "Through Penetration Firestop Systems."

END OF SECTION 16051

SECTION 16055 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Provide coordination study only for the new electrical distribution system from the new circuit breaker in existing Main Distribution Switchboard to all new panelboards and equipment provided in the scope of this project.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified Professional Engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

    a. The following parts from the Protective Device Coordination Study Report:

        1) One-line diagram.
        2) Protective device coordination study.
        3) Time-current coordination curves.

    b. Power system data.

1.07 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 unacceptable.

B. Coordination Study Specialist Qualifications: Professional Engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this Professional Engineer.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

C. Comply with IEEE 242 and IEEE 399.

D. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

E. 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 and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.02 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.

4) Recommendations on improved trip systems, if applicable.

b. Fuses: Show current rating, voltage, and class.

F. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

   a. Power utility's overcurrent protective device.
   b. Generator short-circuit decrement curve and generator damage point.
5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.01 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.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project for new equipment only. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

H. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Standby generators and automatic transfer switches.
3. New branch circuit panelboards.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.
1. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
2. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and Engineers. The qualifications of technicians and Engineers shall be qualified as defined by NFPA 70E.

3.04 FIELD ADJUSTING

A. Make modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

END OF SECTION 16055

SECTION 16056 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during Work on or near electrical equipment.

B. Provide coordination study only for the new electrical distribution system from the new circuit breaker in existing Main Distribution Switchboard to all new panelboards and equipment provided in the scope of this project.

1.03 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified Professional Engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Division 01 Section "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.07 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 unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed Professional Engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional Engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this Professional Engineer.

PART 2 - RODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Comply with IEEE 1584 and NFPA 70E.

B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 16055 "Overcurrent Protective Device Coordination Study."

F. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Equivalent impedance.
d. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
e. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.03 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 16075 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each Work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.02 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 16055 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform Work on energized parts.

E. Safe Working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

G. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the Work location.

H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.03 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
2. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and Engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the Engineer in charge of performing the study, and shall be by the Engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other 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. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.

8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. Motor horsepower and NEMA MG 1 code letter designation.
11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.04 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
   1. Low-voltage distribution panels.

3.05 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

END OF SECTION 16056

SECTION 16060 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.03 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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 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. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.02 CONNECTORS

A. Listed and labeled by an NRTL 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 Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.03 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum. Bury at least 24 inches below grade.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.02 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. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.03 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 2 inches 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.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

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.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ufer Ground (Concrete-Encased Grounding Electrode): In new addition areas, fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.04 LABELING

A. Comply with requirements in Division16 Section "Electrical Identification" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.05 FIELD QUALITY CONTROL

A. 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.
   a. Perform tests by fall-of-potential method according to IEEE 81.

B. 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 Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
3. Pad-Mounted Equipment: 5 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. 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.

D. At stage, music and band rooms, all conduit shall be supported using elastomeric hangers and mounts providing 1/10” minimum deflection such as Mason RWHD and BR, or approved equal.

E. At stage, music and band rooms, all panels shall be mounted to walls using isolator as manufactured by Mason PB, or approved equal.

1.05 SUBMITTALS

A. Product Data: For the following:

1. Steel 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. Equipment supports.

1.06 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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. 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. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. 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: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. 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. 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:

        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, zinc-coated 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. 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:

        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. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.01 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: 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 in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with 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 one-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 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.

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. 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
2. To Light Steel: Sheet metal screws.
3. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, pull and junction boxes, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

3.03 PAINTING

A. Touchup: 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.

END OF SECTION 16073

SECTION 16075 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.03 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, 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

2.01 POWER 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 size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: 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 for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

2.02 ARMORED AND METAL-CLAD CABLE 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. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

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. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.03 POWER AND CONTROL CABLE 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. 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.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.015-inch-thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.04 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. 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.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.015-inch-thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.05 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.06 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Screw Fastened 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:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"

2.07 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches and 1/8 inch 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.

2.08 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch

2.09 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.010 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Select paint system applicable for surface material and location exterior or interior.

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

3.01 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. Attach signs and plastic labels type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot maximum intervals.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit .
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal 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 Bid Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Operating Instruction Signs: 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.

END OF SECTION 16075

SECTION 16120 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 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.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.03 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

2.01 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, UF, USE, and SO.

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC.

2.02 CONNECTORS AND SPLICES

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. 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.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper Solid for No. 10 AWG and smaller; 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.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.

B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. 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.

C. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 16 Section "Identification for Electrical Systems."

G. 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.

H. 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.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (of slack.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables test all light fixtures and occupancy sensors to insure proper operation and compliance with design intent.

C. 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.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

SECTION 16130 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-dieneterpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.04 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.

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.

3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For Professional Engineer and testing agency.

E. Source quality-control test reports.

1.05 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

2.01 METAL CONDUIT AND TUBING

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:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Or approved equal.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel

G. LFMC: Flexible steel conduit with PVC jacket.

H. 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: Steel or die-cast, compression set-screw or compression type.
2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch with overlapping sleeves protecting threaded joints.

I. 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.

2.02 NONMETALLIC CONDUIT AND TUBING

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. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Or approved equal.

C. ENT: NEMA TC 13.

D. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.

E. LFNC: UL 1660.

F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: UL 514B.

2.03 METAL WIREWAYS

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:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Or approved equal.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, 3R, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type or as indicated.

E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect

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. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company The.
c. Wiremold Company The; Electrical Sales Division.
d. Or approved equal.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard custom colors.

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. Butler Manufacturing Company; Walker Division.
b. Enduro Systems, Inc.; Composite Products Division.
c. Hubbell Incorporated; Wiring Device-Kellems Division.
d. Lamson & Sessions; Carlon Electrical Products.
e. Panduit Corp.
f. Walker Systems, Inc.; The Wiremold Company.

g. The Wiremold Company; Electrical Sales Division.
h. Or approved equal.

2.05 BOXES, ENCLOSURES, AND CABINETS

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:

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. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; The Wiremold Company.
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
14. Or approved equal.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes Cast or sheet metal, fully adjustable rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. 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.
2. Nonmetallic Enclosures:

J. 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.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray or Green, match adjacent surface.
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."
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 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

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. 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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e. Or approved equal.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

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:

3. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.
    d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
    e. Or approved equal.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.

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:
3. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell or a comparable product by one of the following:

    a. Carson Industries LLC.
    b. Christy Concrete Products.
    c. Nordic Fiberglass, Inc.
    d. Or approved equal.

2.07 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-inchthickness 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."

2.08 SLEEVE SEALS

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:

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: Plastic. Include two for each sealing element.
3. 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.

2.09 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered Professional Engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: IMC or, Type EPC-40-PVC.
3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
4. Underground Conduit: RNC, Type EPC- 80-PVC, direct buried.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Application of Handholes and Boxes for Underground Wiring:

    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
    b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.

c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbfvertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   b. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: Rigid steel conduit

C. Minimum Raceway Size: 3/4-inch 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.

E. Do not install aluminum conduits in contact with concrete.

3.02 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 inchaway 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 16 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. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inchtrade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. 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.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inch of slack at each end of pull wire.

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. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg Fof temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inch of flexible conduit for recessed and semi recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Provide each flexible connection with enough slack to form an 8” deep U-shaped bend at all motorized/vibrating equipment.

2. Use LFMC in damp or wet locations subject to severe physical damage.

O. 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.

P. Set metal floor boxes level and flush with finished floor surface.

Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 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 2 Section "Earthwork" for pipe less than 6 inchesin nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
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 of concrete.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 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-inchsieve to No. 4sieve 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 above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. 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.

3.05 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. Penetrations of conduit through walls/floors/ceilings shall be oversized by ½” to 1”. There shall be no contact between the penetrating element and the partition, and the resultant gap shall be filled with closed cell foam backer rod and acoustical sealant for an airtight seal. Penetrations through fire walls shall be fire rated.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter, less than 50 inch and no side greater than 16-inch thickness shall be 0.052 inch
2. For sleeve cross-section rectangle perimeter, equal to, or greater than, 50 inch and 1 or more sides equal to, or greater than, 16-inch thickness shall be 0.138 inch

F. 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.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inch above finished floor level.

I. Size pipe sleeves to provide 1/4-inchannular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. 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.

L. 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."

M. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with Roofing Work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inchannular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inchannular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

A. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 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."

3.08 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 16130

SECTION 16139 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Ladder cable trays.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.02 LADDER CABLE TRAYS

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. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Chalfant Manufacturing Company.
3. Cooper B-Line, Inc.
4. Mono-Systems, Inc.
5. MP Husky.
6. Niedax-Kleinhuis USA, Inc.
7. Or approved equal.

B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: 6 inches o.c.
3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: 6 inches.
8. Straight Section Lengths: Refer to Drawings.
9. Width: 24 inches (unless otherwise indicated on Drawings).
10. Fitting Minimum Radius: 24 inches.
11. The maximum uniform load and the support span are indicated by the cable tray class.
12. Class Designation: Comply with NEMA VE 1, Class 12B.

13. Splicing Assemblies: Bolted type using serrated flange locknuts.
14. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.
15. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.03 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.

    a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
    b. Hardware: Chromium-zinc plated, ASTM F 1136.

5. Finish: Electrogalvanized before fabrication.

    a. Standard: Comply with ASTM B 633.
    b. Hardware: Galvanized, ASTM B 633.

6. Finish: Hot-dip galvanized after fabrication.

    a. Standard: Comply with ASTM A 123/A 123M, Class B2.
    b. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.04 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.05 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 16075 "Identification for Electrical Systems."

2.06 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1, NEMA VE 1.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

B. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

C. Remove burrs and sharp edges from cable trays.

D. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

E. Fasten cable tray supports to building structure.

F. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Division 16 "Hangers and Supports for Electrical Systems."

G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

I. Support bus assembly to prevent twisting from eccentric loading.

J. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

K. Support wire-basket cable trays with trapeze hangers.

L. Support trapeze hangers for wire-basket trays with 3/8-inch diameter rods.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Make cable tray connections using manufacturer's recommended fittings.

O. Seal penetrations through fire and smoke barriers. Comply with requirements in Division 07.

P. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

Q. Install cable trays with enough workspace to permit access for installing cables.

R. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

S. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Division 27 "Grounding and Bonding for Electrical Systems."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 16139

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Snap switches and wall-box dimmers.
5. Solid-state fan speed controls.
6. Communications outlets.
7. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge protective device.

F. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. Cooper.
2. Hubbell Incorporated; Wiring Device-Kellems Hubbell.
3. Leviton Mfg. Company Inc. Leviton.
4. Pass & Seymour/Legrand; Wiring Devices & Accessories Pass & Seymour.
5. Or approved equal.

2.02 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 single, 5352 duplex.
b. Hubbell; HBL5351 single, CR5352 duplex.
c. Leviton; 5891 single, 5352 duplex .
d. Pass & Seymour; 5381 single, 5352 duplex.
e. Or approved equal.

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.03 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; SGF20.
b. Pass & Seymour; 2095.
c. Leviton; GFNT2
d. Hubbell; GFST20
e. Or approved equal.

2.04 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.02 IDENTIFICATION

A. Comply with Division 16 Section "Identification for Electrical Systems."

1. Receptacles: Identify Panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following lighting control devices:

1. Indoor occupancy and vacancy sensors.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.04 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.

1.05 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: Two years from date of Substantial Completion.

1.06 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 INDOOR OCCUPANCY SENSORS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawing or a comparable product by one of the following:

1. Sensor Switch, Inc.

2. Or approved equal.

D. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc ; keep lighting off when selected lighting level is present.

E. Dual Technology Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. and detect a person of average size and weight moving not less than 12in. in either horizontal or vertical manner.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 2000 sq. when mounted on a 108-inch high ceiling.

2.02 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawing or a comparable product by one of the following:

1. Sensor Switch, Inc.

2. Or approved equal.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on manually when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Switch Rating: Not less than 800-W LED load at 120 V, 1200-W LED load at 277 V.

C. Wall-Switch Sensor Tag Sos or Svs:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: manual "on," automatic "off."
4. Voltage: Dual voltage - 120 and 277 V.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.

8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
9. Color: White**.**
10. Faceplate: Color matched to switch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

D. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.03 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Division 16 Section "Low voltage electrical power conductors and cables" Minimum conduit size shall be 1/2 inch.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.04 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section " Identification of Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

3.05 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective Work and shall be replaced.

END OF SECTION 16145

SECTION 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. 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."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other Work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
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.

C. Field quality-control reports.

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.

D. Manufacturer's field service report.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Div 01 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.08 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.09 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. 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.

D. 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.

E. Comply with NFPA 70.

1.010 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 and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's Construction Manager's Owner's written permission.
4. Comply with NFPA 70E.

1.011 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.012 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.02 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.03 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. All circuit breakers 1200A or higher shall be provided with Arc Energy Reduction per NEC 240.87.

D. 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.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

H. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

I. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

J. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.04 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO NC contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered;

2.05 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Div. 16 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges

END OF SECTION 16410

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Lighting and appliance branch-circuit panelboards.
   2. Distribution Panel

1.03 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protective Device

C. GFCI: Ground-fault circuit interrupter

D. MCCB: Molded-case circuit breaker

1.04 SUBMITTALS

A. Product Data: For each type of Panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each Panelboard and related equipment.

   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

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. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and 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 that allows adjustments.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. 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.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. 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.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NECA 407.

1.07 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet Work in spaces is complete and dry, Work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F
    b. Altitude: Not exceeding 6600 feet

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than five days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.08 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fails in materials or workmanship within specified warranty period.

1. Warranty Period: three years from date of Substantial Completion.

1.010 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of Panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection GFEP Types: Two spares for each Panelboard.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets as requested.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1
b. Outdoor Locations: NEMA 250, Type 3R
c. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as Panelboard front with flanges for attachment to Panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as Panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel same finish as panels and trim.

7. Directory Card: Inside Panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: Top and bottom as requested.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

3. Neutral Bus: Neutral bus rated 100 percent of phase bus and UL listed.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
3. Main and Neutral Lugs: Mechanical type.
4. Ground Lugs and Bus-Configured Terminators: Mechanical type.
5. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
6. Subfeed Double Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
7. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 POWER PANELBOARDS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors, more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or lugs only as indicated on Bid Drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers

G. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. Or approved equal.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on Bid Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as Panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5. ABB (Asea Brown Boveri)
6. Or approved equal.

B. All circuit breakers 1200A or higher shall be provided with Arc Energy Reduction per NEC 240.87.

C. Molded-Case Circuit Breaker MCCB: Comply with UL 489, 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 circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and 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. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection 6-mA trip.
6. Arc-Fault Circuit Interrupter AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
7. Molded-Case Circuit-Breaker MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge HID lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in ON or OFF position.
    h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in ON position.

2.05 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from Panelboard. Include relay and meter test plugs suitable for testing Panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Mount panel board 6 feet above finished floor to highest operating handle unless otherwise indicated.

C. Mount Panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inchempty conduits from Panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inchempty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 16 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing Panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each Panelboard with a nameplate complying with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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.

B. Panelboards will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a Panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 16442

SECTION 16491 - FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards and enclosed controllers.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves average melt and current-limitation curves instantaneous peak let-through current for each type and rating of fuse. Submit on translucent log-log graph paper.
5. Coordination charts and tables and related data.

B. Operation and Maintenance Data: For fuses 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. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves average melt and current-limitation curves instantaneous peak let-through current for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.05 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.06 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three 3 of each size and type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Or approved equal.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK5, time delay.
   2. Other Branch Circuits: Class RK1, time delay.
   3. Control Circuits: Class CC, fast acting.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 16 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 16491

SECTION 16511 - LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Suspended, linear.
2. Luminaire supports.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Lumen: Measured output of LED.

E. Luminaire: Complete lighting fixture, including driver.

F. LED: Light-emitting diode.

1.04 SUBMITTALS

A. Product Data: For each type of luminaire, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire including dimensions.
2. Energy-efficiency data.
3. Life, output (lumens, CCT, and CRI), and energy-efficiency data for LED.
4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each luminaire type. The adjustment factors shall be for LED and accessories identical to those indicated for the luminaire as applied in this Project.
    a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National

Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

C. Qualification Data: For qualified agencies providing photometric data for luminaires.

D. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.

1. Provide a list of all LED and driver types used on Project; use ANSI and manufacturers' codes.

E. Warranty: Sample of special warranty.

1.05 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

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. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.07 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: five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.02 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit maintenance without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

E. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when LED's are in place.

1. Label shall include the following characteristics:
    a. LED wattage.
    b. CCT and CRI for all luminaires.

F. Internal driver.

2.03 LED LUMINAIRES

A. Driver: shall deliver full range dimming from 0-10V control signal.

B. Nominal lumens as indicated on Drawings, CRI equivalent to fixtures indicated on Drawings, color temperature as indicated on Drawings, and average rated life 50,000 hours unless otherwise indicated.

2.04 LUMINAIRE SUPPORT

A. Comply with Division 16 Section "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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel 12 gage.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.05 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires:

1. Level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and maintenance.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

F. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

G. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, 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 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.

J. Install ceiling support system rods or wires, independent of the ceiling suspension devices for each luminaire. Locate not more than 6 inches from luminaire corners.

K. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.

L. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

M. Connect wiring according to Division 16 Section "Low-Voltage Power Conductors and Cables."

3.03 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

3.04 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. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16511

SECTION 16526 –LIGHTING CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes manually operated, PC-based, digital lighting controls with external signal source and control module.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

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. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks and other devices to be used. Describe characteristics of network and other data communication lines.

C. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

D. Field quality-control reports.

E. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

F. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

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. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70.

1.04 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of software input/output to execute switching or dimming commands.
b. Failure of modular relays to operate under manual or software commands.
c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Five (5) years from date of Substantial Completion.
3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.

1.06 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide basis of design product indicated on Drawings:
1. Current Lighting, Inc.
2. Or approved equal.

2.02 SYSTEM EQUIPMENT

A. Lighting Control Panels: Lighting control system shall consist of a master and remote panel(s) controlled by a 32-channel digital time clock (DTC) that controls and programs the entire lighting control system. The DTC shall supply all time functions and accept external inputs. The DTC shall accept local control and display prompts to the user on an 8 line 21-letter display. The DTC shall accept user input from keypad pushbuttons, connected computer, modem, Ethernet or internet devices. All commands shall be in plain English. User help information shall display on the DTC screen.

B. Digital Switches: All digital switches shall communicate via RS485, CAT5 patch cable with RJ45 connectors. Contact closure style switches are not acceptable. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Ethernet or internet device. Refer to single line diagram for wiring details. Switches which cannot be programmed remotely shall not be acceptable.

C. Photocells: Exterior (PCO) or interior (PCI) photocells shall provide numeric readout on the DTC display in numerical values corresponding to foot-candles values. Each photocell shall provide a minimum of 14 trigger points. Each trigger point can be programmed to control any field configurable relay or zone. Each trigger point shall be set through DTC, locally or remotely. Photocells that require the use of set screws or manual adjustments at the photocell control card shall not be acceptable.

D. Accessory Devices: Accessory lighting control system interfaces to include a dry contact input interface, BMS interface, dimming system interface, Ethernet/internet interface and an interface to Smartbreaker panel boards. Verify and install only those interfaces indicated on the plans.

E. Lighting Control Software: Unity™ lighting control software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. System shall be capable of running optional Unity GX2 lighting control software. Unity GX2 shall provide for importing vector based graphics and a simple interface that allows users or a factory programmer to overlay color “controls” that are associated with relays or collections of relays.

2.03 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Structured Network Digital and Multiplexed Signal Cables: Outdoor rated UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e or 6 for horizontal copper cable.

PART 3 - EXECUTION

3.01 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install wiring in raceways. Minimum conduit size shall be 1/2 inch.

1. For power wiring comply with Division 16 Section " Low-Voltage Electrical Power Conductors and Cables."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

F. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

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. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

D. Lighting controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.03 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

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.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems.

END OF SECTION 16526

SECTION 16721 – NATURAL GAS & CO GAS DETECTION AND ALARM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes CO and Methane monitors, notification appliances.

1.03 ACTION SUBMITTALS

A. Product Data:

1. For each type of monitor, include sensing range in ppm, temperature and humidity range, alarm outputs, display range, furnished specialties, installation requirements, and electric power requirement.

B. Shop Drawings:

1. Wiring Diagrams: Power, signal, and control wiring.
2. Locations of the specific sensors and alarm panel location.

C. Coordination Drawings: Include machinery-room layout showing location of monitoring devices and air-sampling tubing with filter/inlet locations in relation to refrigerant equipment.

D. Product Certificates: For monitoring devices, signed by product manufacturer.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant monitoring equipment and SCBA to include in emergency, operation, and maintenance manuals.

1.05 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. One calibration kit including clean air calibration gas bottle for zero calibration and specific refrigerant calibration gas for span calibration, minimum 58-L capacity, pressure regulator, and tubing.

PART 2 - PRODUCTS

2.01 MANUFACTURERS: Subject to compliance with requirements, provide products by the following:

A. Mine Safety Appliances Company Z Gard

B. Macurco TracXP Gas Detector
C. Or engineer approved equal.

2.02 NATURAL GAS AND CO GAS DETECTION SYSTEM Z GARD CONTROLLER

A. Provide a standalone CO/LEL controller as shown on the plans. The controller shall be housed in a Nema 1 Painted steel enclosure. Operating range shall be from –20 degrees F to 122 degrees F. Units that are not capable of these temperature limits shall be provided with a method of auxiliary heat and fans as required to maintain the required ambient conditions.

B. Controller shall accept 110 Vac, direct to the controller, internal step down transformers shall be provided to power up to the field mounted CO and LEL sensors. System shall be UL and or CSA listed to accommodate controller and step down transformer in one panel. If alternate system requires mounting of more than 1 panel the mfg shall include all costs required for additional field wiring to accommodate this task.

C. The Controller shall be connected via a 4 wire field bus to remotely mounted Z Gard sensors that are automatically recognized and establishes the sensors range and gas type. The sensors shall be linked by a RS485 network communication system. The controller shall continuously monitor the sensors for excessive levels of the Specified target gases and provide the necessary notification controls in the event that the gas levels rise above the preset limits.

D. The controller shall manage the Z Gard S sensor inputs on the RS485 Serial communications network. The controller shall provide minimum of 8 relays that can be used to start fans and open OA Louvers. Upon sensing the concentration of target gas at levels equivalent to the warning or alarm set point the relay contact(s) shall energize signaling the event.

E. The controller shall have a programmable Off time delay function that is adjustable from 0 – 600 seconds. The warning and alarm relay shall deactivate from 0-600 seconds after the warning or alarm occurance has abated.

F. The controller shall have the capability of providing a full scale, 2 wire 4 to 20 ma sourcing analog output that is representative of the highest concentration level of any zone of sensors on the network. This output shall be able to communicate with the BAS system.

G. The Controller shall have a local Readout display indicating the active Sensor Point number, the corresponding gas concentration level and gas type, Warning and Alarm indication, Zone number, number of Sensors, Voting and Diagnostic status of the system. The display will scan through all active channels in 5 second intervals. The readout display will visible from a minimum of 5 feet and will be present always, and will not require being turned on or off.

H. The Controller shall have a LCD Readout for the purpose of displaying the Diagnostic Status of the system and associated Sensors. The User Interface Keypad of 16 items to access the menu driven operating parameters located inside the front door of the enclosure. All setup parameters shall be accessed using the keypad.

I. The controller shall include 4 Common LEDs to indicate Sensor Okay, Warning, Alarm and Sensor Fail status.

J. This Controller shall include a local mounted Audible Alarm rated @ 90 dB with push-button reset switch. The pushbutton reset switch shall silence and reset the Audible Alarm when alarm points are exceeded. The Common LED visual alarms will remain on as long as any Warning or Alarm levels are exceeded. This push-button will reset latched alarms if normal gas conditions exist. A horn relay shall be included to facilitate control of a remote alarm reset pushbutton.

K. Warning and Alarm Set Point Levels - The controller shall provide 4 relays for control of the wall mounted exhaust fans and outdoor intake louvers. Provide manual 3-hour override timers for each relay. Timers shall be labelled to the system served.

L. The controller shall provide a normally energized Sensor Fail Relay. If a loss of communication occurs between the Controller and remote Sensor Transmitter the Sensor Fail Relay will be activated and the Sensor Okay LED located on the Controller door will turn off.

M. All Warning, Alarm and Sensor Fail Relays shall be Form C, single pole, double throw. Contacts shall be rated for 10 Amps 1/8 HP @ 125VAC, 5 amps resistive at 250VAC or 30VDC.

N. The contacts shall be capable of being selected normally open or normally closed.

O. The control panel must be a MSA Z Gard CX or approved equal controller.

P. Optional remote relay panel shall be available for remote fans operation

Q. Bacnet interface shall be included for communications to the BMS system

2.03 Z-GARD CO AND LEL SENSORS

A. Provide as shown on the plans Carbon monoxide and LEL sensors. Sensors have been located for radius coverage and points of egress. Locations as shown on the plans shall not be modified by the manufacturer.

B. Sensors housing shall be Nema 4 enclosure with plastic cover. Sensors shall utilize electro chemical technology. Accuracy of the sensors shall not be less than ±2% of Full Scale with no requirement of periodic addition of reagents. Solid State Sensors shall not be acceptable

C. When used with the Z Gard C Controller: The RS 485 Network communication wiring from the Sensor to the Z Gard C Controller shall be a shielded 4-wire cable of sufficient gage to meet distance requirements of the Z Gard RS 485 Network Communication. The Sensor Transmitter terminal strips shall be removable for ease of wiring and accept up to 10 GA AWG wire.

D. The Sensor electronics shall consist of dual PCB that is microprocessor-based computer-aided and factory-calibrated for the target gas compounds with compensation for ambient humidity and temperature and linearized signal output. The PCB includes all the components required to power, operate the sensor, make calibration adjustments and set the network address jumpers when used in the Z Gard Communication network. The single PCB shall be mounted to the enclosure using industry standard hardware.

E. CO sensors shall be located at 5’ AFF

F. LEL sensors shall be located 12“ Below the Roof Line

2.04 MONITOR ALARM SEQUENCE

A. The MSA Control panel will constantly Poll the CO and LEL sensors located in the Boiler Room Upon increase in CO levels above 25 PPM or LEL levels above 10% LEL the alarm shall sound.

B. If the CO increase above 35 PPM or the LEL increase above 35% LEL the 2nd alarm contact shall close and the boilers shall be checked to ensure they are working properly.

2.05 NOTIFICATION APPLIANCES

A. Horns: Comply with UL 464; electric-vibrating-polarized type, listed by a qualified testing agency with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

B. Visible Alarm Devices: Comply with UL 1971; three color xenon strobe lights, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The words "CO - GAS DETECTION" printed in minimum 1/2-inch-high letters on the lens. Rated light output is 75 candela.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount sensors in accordance with manufacturer’s recommendations.

B. Wall mount monitor panels with top of unit 60 inches above finished floor.

C. Audible Alarm-Indicating Devices: Install at each entry door to, mechanical equipment room, and position not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

D. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn at each entry door to mechanical equipment room. Install in accordance with manufacturers recommendations.

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. 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.

C. 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.

D. Tests and Inspections:

1. Inspect field-assembled components, equipment installation, and electrical connections for compliance with requirements.
2. Test and adjust controls and safeties.
3. Test Reports: Prepare a written report to record the following:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Repair or replace malfunctioning units and retest as specified above.

3.03 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain refrigerant detection devices and equipment. Refer to requirements in Division 01.

END OF SECTION 16721

SECTION 16800 – EMERGENCY RESPONDER RADIO SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY – PERFORMANCE SPECIFICATION

A. Pre-installation Testing - Contractor shall perform pre-installation testing for percent coverage and signal strength in accordance with all applicable codes. Testing shall not be performed until after the building is fully enclosed (roof, exterior skin, doors and windows are installed), and interior ceilings and walls are in place.

B. Performance specification for an Emergency Responder Radio Coverage (ERRC) System and related equipment as required by Section 510 of the International Fire Code (IFC).
   1. In compliance with Section 510 of the IFC, the building is to support adequate radio coverage for various emergency services workers, including but not limited to firefighters and police officers.

C. Design, furnish, install, and test a complete and operating ERRC System. The system will support the radio systems for various emergency services workers, including but not limited to the Local Fire Department and Local Police Department.

D. This Section includes the requirements for an ERRC for the purposes of amplifying Emergency Responder radio signals to achieve minimum signal strength of -95 dbm in 95% of all areas of the high school building and 99% in elevators (measured at the primary recall floor), stair shafts, and fire command centers.

E. Provide two-way ERRC to enable communications between emergency responders at the exterior perimeter of the buildings and emergency responders within the buildings. All areas of the buildings shall have code compliant radio coverage.

F. Final acceptance and approval is required from the local Fire Department and Police Department in writing prior to contract closeout.

1.03 REGULATIONS

A. Codes, regulations and standards.
   1. NFPA 70 – The National Electrical Code
   2. NFPA 72 - National Fire Alarm Code
   3. NEC – National Electric Code

4. New Jersey IBC
5. FCC 47 CFR Private Land Mobile Radio
6. NFPA 101, Life Safety Code and Local Code and Building Authority requirements.
7. ADA “Americans with Disabilities Act”
8. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
9. FCC Rules Part 22, Part 90 and Part 101.

1.04 DEFINITIONS

A. Bi-Directional Amplifier (BDA): Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage.

B. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.

C. Delivered Audio Quality Definitions (DAQ): This is a universal standard often cited in system designs and specifications.
   1. DAQ 1: Unusable, speech present but unreadable.
   2. DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
   3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
   4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion
   5. DAQ 4: Speech easily understood. Occasional noise/distortion.
   6. DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
   7. DAQ 5: Speech easily understood. Coupled Bonding Conductor (CBC) – The term "Coupled Bonding Conductor" shall mean a bonding conductor placed, e.g. strapped, on the outside of any technology cable, used to suppress transient noise.

D. FCC: Federal Communications Commission

E. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

F. Public Safety/First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to: law enforcement departments, fire departments, and emergency medical companies.

1.05 DELEGATED DESIGN SUBMITTALS

A. Submit product data for each type of proposed system component specified, including dimensioned drawings showing minimum clearances and installed features.

B. Layout Drawings:
   1. Component specification sheets shall be 8.5-inch x 11 inch or greater, scaled or dimensioned, with dimensions or scale clearly noted.
   2. Floor plan drawings scaled to legible size.
   3. Floor plan drawings may include elevation detail names for each elevation view. Sheet title shall include site name, address, sheet number, floor plan number and north arrow. Include site plan view of the subject buildings and surrounding property to clearly indicate the location and orientation of roof mounted outdoor antennas associated with the proposed system.
   4. Include a minimum of (1) building elevation depicting the location of any outdoor antennas associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections.
   5. Include a detail plan view of all Telecommunications Spaces housing head-end and/or other consolidated equipment, showing the location of the rack(s) and/or enclosure(s) of the Emergency Responder Radio Antenna/Repeater System equipment.
   6. Include a separate plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coaxial cable routes, and the locations of any other system components including splitters, couplers, filters, amplifiers, etc. All components shall be named or labeled for reference in power budget calculations tables. Overlay approximated coverage radii indicating –95 dbm downlink (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.
   7. Include a minimum of one (1) detail elevation view(s) of all rack(s) and/or enclosure(s) housing the Emergency Responder Radio Antenna/Repeater System equipment. Identify each piece of equipment by brand, model number and equipment type.
   8. Specify antenna grounding and surge protection in accordance with NEC Article 810.
   9. Specify the backup power source (Life Safety), and include calculations to ensure the backup power requirements as specified in this standard are met.

C. Equipment Specification Sheets.
   1. Provide copies of manufacturer specification sheets of all system components, including:
      a. Amplifiers
      b. Antennas
      c. Coaxial cable, couplers, splitters, combiners, or other passive components
   2. Operation and maintenance data.
   3. Pass band curves in for the uplink and downlink portions of the NPSPAC band for any amplifiers, if not included in #1. Amplifiers may NOT amplify portions of other licensed services, including Nextel and Specialized Mobile Radio Licensee band, or Cellular A or B bands.
   4. Backup battery and charging system.

D. Submit wiring diagrams from manufacturer differentiating clearly between factory and field-installed wiring. Include diagrams for each component of the system with all terminals and interconnections identified. Make all diagrams specific to this Project.

E. Submit product certificates signed by the manufacturer of radio system components certifying that their products comply with specified requirements.

F. Submit agenda for training class and copies of all handouts for the class.

G. Maintenance data for radio system shall be included in the operation and maintenance manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

H. Record of field tests of the radio system shall be included in the operation and maintenance manuals.

I. Design Approval: Plans shall be submitted and approved prior to installation. The following information shall be provided to the local Fire Department unit representative by the system designer/Contractor.
   1. A minimum of three (3) copies of detailed drawings showing the location of the amplification equipment and associated antenna systems which includes a view showing building access to the equipment; and
   2. A minimum of three (3) copies of schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment including panel locations and labeling.
   3. A minimum of one (1) copy of the Manufacturer's data sheets on all equipment to be installed.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Single-Source Responsibility: Obtain radio system components from a single source who assumes responsibility for compatibility of system components.

C. All equipment shall be UL listed and labeled, and in accordance with applicable NEMA and ANSI Standards. Where copper cabling is routed to an area, either in another building, or with a separate electrical service, the Technology Contractor shall provide primary protective equipment.

D. All ERRC equipment shall be FCC certified.

E. The contractor shall be FCC licensed as required by code.

F. Components of the ERRC shall industry standard and readily available.

G. All racks and enclosures shall be either welded or assembled with paint piercing ground washers, grounding strip and bonding jumper shall be provided.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace ERRC system equipment and components that fail in materials or workmanship within specified warranty period.
   1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. The detailed technical design of the ERRC shall be the responsibility of the contractor.
   1. Contractors must obtain approvals from the State of New Jersey Department of Community Affairs (DCA), as well as coordinate and obtain approvals from the local Fire Department, local Police Department, the FCC, and any other emergency responders, in order to define the system and frequencies to be used.
      a. Trunk System Frequencies
      b. Conventional Frequencies
         1) 700 & 800 MHz bands allocated for fire and police

2.02 MANUFACTURERS:

A. Subject to compliance with requirements, available Integrators offering products that may be incorporated into the Work include the following:
   1. CommScope/Andrew
   2. Westell
   3. Times Microwave
   4. Tessco Technologies
   5. CCI (Communication Components Inc.)
   6. Solid Technologies
   7. Or engineer approved equal.

2.03 GENERAL PERFORMANCE REQUIREMENTS

A. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.

B. Power Supplies: At least two (2) independent and reliable power supplies shall be provided, one primary and one secondary. The primary power source shall be supplied from a dedicated 20 ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall be a dedicated battery, capable of operating the in-building radio system for at least 12 hours of 100% system operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 or 4X

type enclosures. Monitoring the integrity of power supplies shall be in accordance with 4.4.7.3 of NFPA 72.

C. Provide a UPS sized to provide emergency power to ERRC headend and node equipment for a minimum of 24 hours. Connect the UPS to the emergency generator power circuit.
   1. UPS shall be enclosed in a NEMA Type 4 enclosure.
   2. UPS batteries shall be of the sealed maintenance-free type.
   3. Provide battery ventilation in accordance with code, if required.

D. Provide supervision of the ERRC antennas, signal boosters, power supplies and UPS.
   1. Provide supervisory and trouble alarm output contacts indicating an impairment. Connect the supervisory and trouble alarm contacts to the building fire alarm system.
   2. Program the fire alarm system to relay ERRC supervisory and trouble alarm signals to the appropriate supervising station. Instruct supervising station personnel to notify the local fire and police departments of an impairment.

E. Survivability
   1. Physical Protection: All wiring and fiber optics shall be installed in conduit. Refer to Division 16 Section, "Raceways and Boxes for Electrical Systems" for type, sizing and installation standards.
   2. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
      a. A 2-hour fire rated cable or cable system.
      b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
      c. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s). The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.
      d. Performance alternative approved by the authority having jurisdiction.
   3. Cabinet: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: –22 degrees F to +120 degrees F (–30 degrees C to +50 degrees C) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.
   4. Passive Equipment: Passband shall be 700-900 MHz, IP rating of 2 GHz.
   5. Cable: Passband shall be 700-900 MHz. Cable shall be rated for fire plenum and riser rating.

2.04 SYSTEM COMPONENTS

A. Signal Strength
   1. Downlink: A minimum signal strength of -95 dBm shall be provided throughout the coverage area.
   2. Uplink: Minimum signal strength of -95 dBm received at the local Fire Department Radio System from the coverage area.

3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

B. Permissible Systems
   1. Buildings and structures shall be equipped with an FCC Certificated Class B Bi-Directional UHF Amplifier(s) as needed.
   2. The distributed antenna system may utilize a radiating cable, fixed antennas or a combination of both.

C. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 MHz public safety bands as utilized by the local Fire Department.

D. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MH.

E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.

G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications.

H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.05 SYSTEM MONITORING

A. The distributed antenna system shall include a connection to the fire alarm system to monitor the integrity of the circuit of the signal booster(s) and power supplies and annunciate this malfunction on the fire alarm system shall comply with 4.4.7.1 of NFPA 72.

B. A sign shall be located at the fire alarm panel with the name and telephone number of the local Fire Department indicating that they shall be notified of any failures that extend past the 2 hour time limit.

PART 3 - EXECUTION

3.01 PRE-INSTALLATION TESTING

A. Contractor shall perform pre-installation testing for percent coverage and signal strength in accordance with all applicable codes. Testing shall not be performed until after the building is fully enclosed (roof, exterior skin, doors and windows are installed), and interior ceilings and walls are in place.
   1. Measure the percent coverage and signal strength in both the critical and general areas on each floor. Measure the signal strength receivable within the building and the signal strength received when transmitting from within the building.
   2. Install amplification only on the floors which fail to have the required percent coverage and signal strength in accordance with all applicable codes.
   3. Provide spare capacity to install amplification later on floors that pass pre-installation testing but may drop below the required percent coverage or signal strength when construction and furniture move-in are completed.

3.02 INSTALLATION

A. Distribution System Signal Wires and Cables
   1. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
   2. Routing and Interconnection
      a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit or cable tray that is secured to building structure.
      b. Completely test all of the cables after installation and replace any that are found to be defective.
   3. Install cables without damaging conductors, shield, or jacket.
   4. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.
   5. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

B. Product Delivery, Storage, and Handling
   1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
   2. Store and protect equipment in a conditioned space until installation.

C. System Installation
   1. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
   2. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
   3. Coordinate all roof penetrations with Owner and/or roofing contractor.

3.03 LICENSING

A. All fees associated with the licensing shall be paid by the Contractor.

B. All testing must be done on frequencies authorized by the FCC.

3.04 GROUNDING

A. Ground cable shields and equipment per Manufacturer's requirements.

B. Antenna mast shall be grounded per NFPA 70 NEC requirements, Division 16 Section, "Grounding and Bonding" and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.05 APPROVAL TESTING

A. The Architect/Engineer shall review plans and specifications prior to any installation of ERRC. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the architect/engineer.

B. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the local Fire Department unit. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

C. Testing Procedures
   1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the delivered audio quality (DAQ) system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.
   2. Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.

D. Final Acceptance Testing
   1. All acceptance testing shall be done in the presence of a local Fire Department representative or by the local Fire Department unit at no expense to the City.
   2. Small scale drawings (11-inch x 17-inch maximum) of the structure shall be provided by the Contractor to the architect/engineer. The plans shall show each floor divided into the grids as described above, and the results of the pre-testing. Each grid shall be labeled to indicate the DAQ result from the final acceptance testing.
   3. The Contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal to the architect/engineer.

4. Include testing results of the repeater (output wattage, gain level, etc) and connection to the fire alarm.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 16800