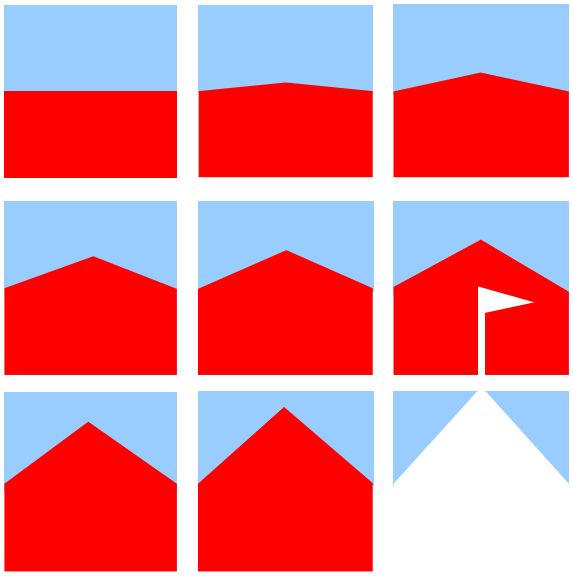
Addition to Seaford Elementary School

York County School Division



PROJECT MANUAL

HUDSON + ASSOCIATES
ARCHITECTS

September 16, 2013

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COUNTY OF YORK, VIRGINIA
INVITATION FOR BIDS (IFB)

Issue Date: November 11, 2013 **IFB No. 1893**

Title: Seaford Elementary School Six Classroom Addition

Classification Code: 91079

*Issuing Agency: County of York, Virginia
Central Purchasing
120 Alexander Hamilton Blvd/PO Box 532
Yorktown, Virginia 23690

Using Agency And/Or Location Where Work Will Be Performed: County School Board of York County, Virginia
302 Dare Road
Yorktown, Virginia 23692

Sealed Bids will be received until Thursday December 12, 2013 at 3:00pm at 120 Alexander Hamilton Blvd., Yorktown, Va. 23690, 2nd floor, Purchasing Office, at which time all bids shall be Opened In Public And Read Aloud.

Note: Bidders are strongly encouraged to attend an **Optional Pre-Bid Conference to be held on Tuesday November 26, 2013 at 10:00am. Location: Seaford Elementary School 1105 Seaford Road, Seaford, Va. 23696.** Meet at the main office. (See Section 3.0).

All Inquiries; Information Should Be Directed To: Victor Robinson, Buyer. Telephone: (757) 890-3680 victor.robinson@yorkcounty.gov.

***SEND BIDS DIRECTLY TO THE ISSUING AGENCY SHOWN ABOVE.**

In Compliance With This Invitation For Bids And To All The Conditions Imposed Herein, The Undersigned Offers And Agrees to Furnish The Products, Materials And Services Described At the Prices Indicated In Section 20.0.

Name and Address of Firm:

_____ Date: _____

_____ By: _____
Signature in ink

_____ Title: _____

Telephone No.: _____ Type/Print Name: _____

Facsimile No.: _____ Federal Tax ID#: _____

SCC # _____ E-mail: _____

1.0 PROJECT DESCRIPTION

The Project consists of constructing a 7,985 SF, six classroom, addition to Seaford Elementary School and related demolition, site preparation, storm water management, utilities, a closed loop geothermal heat pump HVAC system, mechanical and plumbing systems in support thereof with a separate roof ventilating unit to provide the outside air requirement, as shown in the Project Manual prepared by Hudson + Associates, Architects dated September 16, 2013, entitled Addition to Seaford Elementary School York County School Division. Work shown on the Project Manual includes two additive alternates. **Alternate 1** is a closed loop geothermal variable refrigerant flow AC system, mechanical and plumbing systems in support thereof with a separate roof ventilating unit to provide the outside air requirement. **Alternate 2** is the enclosure of an existing 518 SF breezeway between the existing building and the detached gymnasium.

It is the express intent of this formal Invitation For Bids (IFB) to acquire the services of a fully qualified Contractor, hereinafter the "Contractor", to complete the construction of an addition, renovation and associated site work at Seaford Elementary School for the County School Board of York County, Virginia, hereinafter "Owner", in accordance with all applicable Federal, State, and Local government laws, ordinances, rules, regulations and these specifications, at the prices offered on the Bid Form/Bid Schedule (Section 20.0).

2.0 SUMMARY OF SCOPE OF WORK:

The successful Contractor shall provide all material, tools, equipment, labor, supervision, warranty, and insurance required to complete the work described in full in the Project Manual dated September 16, 2013 "Addition to Seaford Elementary School York County School Division", prepared by Hudson & Associates Architects.

Work shall be performed at Seaford Elementary School, located at 1105 Seaford Road, Seaford, VA 23696, and in accordance with the specifications and terms and conditions contained herein and in the Project Manual at the prices provided by bidder on the Bid Form/Bid Schedule (Section 20.0 of IFB 1893)

A. The project includes construction of a one-story, six classroom masonry bearing wall addition. Foundations are shallow concrete with a slab on grade floor. The roof structure is steel bar joists and metal roof deck. Exterior materials include two colors of face brick, composite architectural wall panels and a cold applied two-ply modified bitumen roof system on polyisocyanurate insulation and a cover board. Exterior doors are hollow metal and windows are double thermal break storefront aluminum with insulated glazing.

B. Interior finish systems include painted block, abuse resistant GWB and CFM stud framing, acoustical panel ceilings, ceramic tile restroom floors and vinyl composition floor tiles in the corridor and classrooms. Interior doors are prefinished wood in hollow metal frames.

C The base bid HVAC is a closed loop geothermal heat pump system. Outside air is provided to the classrooms from a roof mounted ventilation unit (RVU). This unit is manufactured by Engineered Air and there are NO SUBSTITUTIONS allowed.

D. Alternate 1 changes the base bid HVAC system to closed loop geothermal variable refrigerant flow HVAC system. The classroom units shall be provided as ceiling cassettes

with a ducted concealed unit provided in the corridor. The VRF piping and system components indicated in the Contract Documents shall be installed in accordance with the manufacturer's recommendations. The VRF system shall be City-Multi as manufactured by Mitsubishi with NO SUBSTITUTIONS. Outside air is provided to the classrooms from a roof mounted ventilation unit (RVU). This unit is manufactured by Engineered Air and there are NO SUBSTITUTIONS allowed.

E. Gas service to the RVU will be from the existing meter located near the existing electric room and then underground to the east side of the addition and then above the addition's ceiling and through the roof to the RVU.

F. Electrical service to the addition will come from several sources including tapping an existing spare 400 amp breaker at the MDP in the existing building. This will be routed underground from the existing electric room to an existing handhold and beyond to the electric room in the addition.

G. Power and lighting requirements are shown on the construction documents. Wiring for phone, data, security, HVAC controls (excluding all City-Multi control wiring), fire alarm and security systems are handled by the Owner's Contractors. Conduit for these systems are part of the construction contract. See WORK

H. Sanitary sewer for the addition will replace a portion of the existing sanitary sewer on the north side of the existing school and then combine the addition's sanitary piping into the replaced sanitary lines.

I. The site development will include providing and enlarging fire access drives to the site; the addition of a fire hydrant; storm water filtering and an underground storage system; and the demolition salvage and reinstallation of an existing playground on the north side of the addition.

J. The addition is designed as a separate building from the existing school. It is separated from the existing school by three-hour fire walls including a three-hour fire rated door vault where the addition and the existing join. The main corridor is designed with one-hour fire barrier walls. The openings in these walls have fire rated doors and frames.

K. Alternate 2 encloses the existing covered breezeway between the east end of the existing school and the existing gymnasium. This work will not commence until June 16, 2014 and must be substantially complete or meet final completion by August 15, 2014.

L. The Owner has conducted hazardous material testing in the building. The transite panels over the kitchen window that are to be removed are considered construction waste. If during the course of the work suspicious material is encounter, immediately notify the Mr. Frank Pitchford, YCSD's Safety Manager (e-mail fpitchford@ycsd.york.va.us or phone (757)876-8801). Mr. Pitchford will conduct testing and prepare abatement specifications and procedures as required.

2.1 CONTRACT TIMELINE:

The Contractor shall have access to the site commencing with the Notice to Proceed. **All work must be substantially completed by August 15, 2014. Final Completion shall be no later than September 15, 2014.**

3.0 PRE-BID CONFERENCE:

Bidders are invited and strongly encouraged to attend a pre-bid conference to be held on, **Tuesday November 26, 2013 at 10:00am. Location:**
Seaford Elementary School, 1105 Seaford Road, Seaford, VA 23696 Please assemble at the Main Office. Picture ID is required.

4.0 PLANS AND SPECIFICATIONS:

Plans and specifications may be obtained from the office of the Central Purchasing Division, County of York, Virginia, 120 Alexander Hamilton Boulevard (2nd Floor), Yorktown, Virginia 23690, hereinafter "Central Purchasing". A non-refundable deposit in the amount of ($100.00) One-Hundred dollars payable by check to: Treasurer, County of York, Virginia, will be required for the first set of Bidding Documents supplied to each bidder. Requests for Plans and Specifications to be mailed/shipped must be in writing and accompanied by an additional non-refundable check for copying and mailing costs in the amount of $20.00 for each set of plans requested made payable to: Treasurer, County of York, Virginia. Deposits for plans and specifications in excess of one set per Contractor will be an additional $100.00 non-refundable fee. Plans and specifications may also be available for examination at the plan rooms of the Builders Exchange and F.W. Dodge.

5.0 GENERAL TERMS AND CONDITIONS:

Except to the extent further modified by this IFB, the General Terms and Conditions are set out in AIA Document A201 (1997 edition), as modified by the Supplemental Conditions. Hereinafter, all references to AIA Document A201 shall mean AIA Document A201 (1997 edition) as so modified.

5.1 APPLICABLE POLICY:

This solicitation is subject to the provisions of the County of York, Virginia Ordinance/ Procurement Policy No. 10-19, and any revisions thereto.

5.2 MANDATORY USE OF FORM:

All responses to an Invitation for Bid (IFB) must be submitted on and in accordance with this form. If more space is required to furnish a description of the goods and/or services offered or delivery terms, bidder may attach a letter hereto which will be made a part of the bid. All bids must be submitted in a sealed envelope plainly marked with the IFB number, date and time of bid opening.

5.3 OPENING DATE/TIME:

Bids and amendments thereto, or withdrawal of bids submitted, if received by the County of York, Virginia, Central Purchasing, at 120 Alexander Hamilton Blvd., Yorktown, VA 23690 after the date and time specified for the scheduled bid opening, will not be considered. It will be the responsibility of bidder to see that its bid is in Central Purchasing by the specified time and date. There will be no exceptions. Date of postmark will not be considered. Phone or telegraphic bids (including FAX) will not be accepted.

5.4 INCONSISTENCIES IN CONDITIONS:
In the event there are inconsistencies between the Terms and Conditions of AIA Document A201-1997, as modified by the Supplemental Conditions, and the Invitation For Bids 1893, the latter document shall take precedence.

5.5 CLARIFICATION OF TERMS:
Questions about the specifications or other solicitation documents, should be directed to the Buyer whose name appears on the face of this solicitation. Any revisions to the solicitation will be made only by written addendum issued by Central Purchasing.

5.6 TESTING/INSPECTION:
Central Purchasing and the Owner reserve the right to conduct any test or inspection it may deem advisable to ensure that goods and services conform to the specifications. Owner may require a demonstration of equipment offered by Bidders.

5.7 INVOICING/PAYMENTS TO THE CONTRACTOR:
Billings to the Owner shall be by issuance of a Certificate for Payment by the Architect in accordance with AIA Document A201-1997, as modified herein, and shall reference the purchase order number. Upon issuance of a Certificate for Payment by the Architect and verification and acceptance of same by the Owner that Contractor is in full compliance with the terms of the Contract documents, the Owner shall issue payment based on the Certificate for Payment to the Contractor within thirty (30) days after receipt of the Certificate of Payment.

5.8 ETHICS IN PUBLIC CONTRACTING:
By submitting its bid, all bidders certify that its bid is made without collusion or fraud and that it has not offered or received any kickbacks or inducements from any other bidder, supplier, manufacturer or subcontractor in connection with its bid, and that it has not conferred on any public employee having official responsibility for this procurement any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised unless consideration of substantially equal or greater value was exchanged.

5.9 AVAILABILITY OF FUNDS:
It is understood and agreed between the Contractor and the Owner that the Owner shall be bound hereunder only to the extent of the funds available or which may hereafter become available for the purpose of this IFB.

6.0 INFORMATION FOR BIDDERS:
Bids must comply with all of the requirements of this IFB.

6.1 Award will be made to the lowest responsible and responsive bidder. The quality of the products and services to be supplied, their conformity with the specifications, their suitability to the requirements of the Owner, and the delivery/completion terms will be taken into consideration in making the award. The Owner reserves the right to reject any and all bids, award this contract in whole or in part, and to waive any informalities in bidding.

6.2 Cash discounts may be offered by bidder for prompt payment of bills, but such discount will not be taken into consideration in determining the low bidder but will be taken into consideration in awarding tie bids. The discount period will be computed from the date delivery/completion is accepted by Owner or from date correct invoice is received by the Owner, whichever is the later date.

6.3 Acceptance of a bid on behalf of Owner, Central Purchasing, is not an order to proceed.

6.4 Each bid is received with the understanding that the acceptance in writing by the Owner of the offer to furnish any or all of the equipment and services described therein, shall constitute a contract between the bidder and the Owner, which shall bind the bidder on his part to furnish and deliver the equipment and services bid on at the price(s) stated and in accordance with the conditions of said accepted bid; and the Owner on its part to pay for, at the agreed prices, all services specified and delivered in accordance with the contract documents.

6.5 Unless qualified by the provision **"NO SUBSTITUTE" or "NO SUBSTITUTIONS"**, the use of the name of a manufacturer, brand, make or catalog designation in specifying an item does not restrict bidders to the manufacturer, brand, make or catalog designation identification. This is used simply to indicate the character, quality and/or performance equivalence of the commodity desired, but the commodity on which bids are submitted must be of such character, quality and/or performance equivalence that it will serve the purpose for which it is to be used equally as well as that specified. In submitting bids on a commodity other than as specified, bidder shall furnish complete data and identification with respect to the alternate commodity he proposes to furnish.

Consideration will be given to bids submitted on alternate commodities to the extent that such action is deemed to serve best the interests of the Owner. If the bidder does not indicate that the commodity he proposes to furnish is other than specified, it will be construed to mean that the bidder proposes to furnish the exact commodity described.

6.6 Bidder declares that the bid is not made in connection with any other bidder submitting a bid for the same commodity or commodities, and that the bid is bona fide and is in all respects fair and without collusion or fraud.

6.7 All prices and notations must be in ink or typewritten. No erasures permitted. Mistakes may be crossed out and corrections made in ink adjacent and must be initialed and dated in ink by person signing bids.

6.8 All bids must be signed with the firm name and be signed by an officer or authorized employee of the firm. In the case of a corporation, the title of the officer signing must be stated and each officer must be duly authorized. In the case of a partnership, the signature of at least one of the partners must follow the firm name using the term "member of the firm" or "general partner". In the case of a limited liability company, the bid must be signed by the manager (if any) or by a member.

6.9 Verify your bids before submission as they cannot be withdrawn or corrected after being opened.

6.10 If you do not bid, return this sheet and state reason. Otherwise your name may be removed from our mailing list.

6.11 The time of proposed completion of the project must be stated in definite terms in Section 22.0.

6.12 The Owner reserves the right to reject any and all bids in whole or in part, and to waive any informality or technical defects if, in its judgment, the best interests of the Owner will be served.

6.13 Any equipment delivered must be standard new equipment latest model, except as otherwise specifically stated in bid. Where any part or nominal appurtenances of equipment is not described, it shall be understood that all the equipment and appurtenances which are usually provided in the manufacturer's stock model shall be furnished.

6.14 Samples, when requested, must be furnished free of expense, and if not destroyed will, upon request, be returned at the bidder's risk and expense.

6.15 Length of time for completion/delivery as well as price may be considered in awarding of the bid.

7.0 BID SECURITY:

Bids shall be accompanied by a bid guarantee of not less than Five Percent (5%) of the bid, which may be a Bid Bond, a Certified Check, or Cashier's Check, made payable to Treasurer, York County, Virginia. Such Bid Bond or check shall be submitted with the understanding that it shall guarantee that the bidder will not withdraw his bid for a period of sixty (60) days; and, that if his bid is accepted, he will enter into a formal contract with the Owner, and the required bonds will be given.

8.0 SILENCE OF SPECIFICATIONS:

The apparent silence of these specifications and any supplemental specifications as to any detail or the omission from the specifications of a detailed description concerning any point shall be regarded as meaning that only the best commercial practices are to prevail and that only materials of the highest quality and correct type, size and design are to be used. All interpretation of these specifications shall be made on the basis of this statement.

9.0 WORK SITE DAMAGES / REPLACEMENT OF DAMAGED PROPERTY

The Contractor shall replace or repair any property damaged by Contractor, subcontractor(s), or their employees and/or agents, including but not limited to any damages to finished surfaces, existing structures, fences, trees, plants, grass, walks, drives, and building surfaces, without limitation. Contractor shall restore to its original condition any real or personal property, equipment or materials, whether that of the Owner's or belonging to a private party, that is damaged as a result of work associated with this Project. All such repair and/or replacements

shall be to the Owner's satisfaction, at no cost to the Owner, and at the Contractor's sole expense.

10.0 ALTERNATIVE MATERIALS

All materials specified have been determined to have characteristics appropriate for the purposes of this Project. When the drawings or specifications specify one or more manufacturers' brand names or makes of materials, devices or equipment as indicating a quality, style, appearance or performance, the bidder shall base his bid on either one of the specified brands. Unless the clause "or equal" is used in the specifications or scope of work pertaining to the material or article, only the specified items shall be used. In the event, however, that the clause "or equal" is used in the specifications pertaining to the material or article, the proposed use of an alternate article other than that specified must be approved by the Owner. Use of an alternate shall not be permitted unless it has been found to be equal or better by the Owner and at no additional cost.

The burden of proof as to the comparative quality and suitability of alternative equipment, articles or materials shall be upon the bidder and he shall furnish at his own expense, such information relating thereto as may be required by the Owner. The Owner shall be the sole judge as to the comparative quality and suitability of alternative equipment, articles or materials and its decision shall be final and unreviewable.

Requests for approval of alternate products shall be submitted in writing to the Central Purchasing Office a minimum of seven (7) calendar days prior to the due date and time of the bids and shall include manufacturers samples(s). Consideration will be given to bids submitted on alternate commodities to the extent that such action is deemed to serve best the interests of the Owner. If the bidder does not indicate that the commodity he proposes to furnish is other than specified, it will be construed to mean that the bidder proposes to furnish the exact commodity described.

Substitution of equipment, articles or materials for specified items or approved alternates after bid opening may not be made without the prior written approval of the Owner.

11.0 NEGOTIATION WITH LOWEST RESPONSIBLE BIDDER:

Unless canceled or rejected, a responsive bid from the lowest responsible bidder shall be accepted as submitted, except that if the bid from the lowest responsible bidder exceeds available funds Central Purchasing reserves the right to negotiate with the apparent low bidder to obtain a mutually agreeable contract price. The negotiations shall be confined to a reduction in the contract price and shall not deal with changes in the contract requirements.

12.0 AWARD AND EXECUTION OF CONTRACT:

12.1 Award of Contract:
The contract will be awarded or the bids rejected as soon as reasonably possible, but not later than sixty (60) days after the date of opening bids, unless the period for acceptance is otherwise extended at request of Owner and agreed to in writing by the bidder, or bidders.

12.2 Form of Contract:
An example of the proposed contract format is enclosed. Both parties shall execute this contract prior to approval by the County Attorney.

Copies of the required Payment and Performance Bonds are also attached.

12.3 Entering Contract:
Upon award of the Contract to a bidder, such bidder shall enter into the Contract by signing the Contract and by furnishing the Bond(s) for faithful performance as prescribed herein and the Certificate of Insurance as prescribed, which are required to be procured by the Contractor within ten (10) calendar days after the date of the award or within such further time as the Owner may allow. All documents referred to, except the Certificate of Insurance, are attached hereto.

No contract shall result from the submission of any bid and no liability shall accrue with respect thereto until a written contract and accompanying documents have been fully and completely executed on the part of the successful bidder and the Owner. However, failure by the successful bidder to enter into a written contract shall cause the successful bidder to forfeit the full amount of the bid guarantee to the Owner.

12.4 Execution of Documents:
All documents which the bidder is required to execute shall carry the signature of the president of the corporation, the corporate seal and shall be attested to by the secretary of the corporation provided, however, if the board of directors of a corporation authorizes another officer to act for the corporation, then a sealed and attested copy of such authorization shall accompany the signature of such other officer. In the case of an individual, the individual to be bound shall sign; and in the case of a partnership, the signature of a partner shall bind the partnership; and in the event of a limited liability company, a member (or the manager, if any) shall sign.

13.0 GUARANTEE:
All materials and equipment furnished by the Contractor for use in the roof work portion of the Seaford Elementary School addition and all work involved in said roof work portion of the Seaford Elementary School addition included in this Contract shall be and the same are hereby guaranteed by the Contractor free from defects owing to faulty materials or workmanship for a period of two (2) years after date of substantial completion of the work. All such materials and equipment, furnished by the Contractor and all such work involved in the roof work portion of the Seaford Elementary School addition included in this Contract which proves defective, by

reason of faulty material or workmanship within said period of two (2) years, shall be replaced by the Contractor free of cost to the Owner.

All other materials and equipment, furnished by the Contractor, and all other work involved in this Contract shall be and the same are hereby guaranteed by the Contractor free from defects owing to faulty materials or workmanship for a period of one (1) year after date of substantial completion of the work. All other materials and equipment, furnished by the Contractor, and all other work involved in this Contract which proves defective, by reason of faulty material or workmanship within said period of one (1) year, shall be replaced by the Contractor free of cost to the Owner.

Nothing herein shall be deemed a waiver of any other available remedy for contract default, or as a waiver of any applicable statutory limitations period, nor as a waiver of any other applicable warranty period.

14.0 SUPPLEMENTAL CONDITIONS:

The following Supplemental Conditions modify the "General Conditions of the Contract for Construction", AIA Document A201 - 1997. Except where the General Conditions are modified or deleted by these Supplemental Conditions, the unaltered portions of the General Conditions shall remain in full force and effect, but subject to further modification by IFB 1893.

SUPPLEMENTAL CONDITIONS

ARTICLE 1; GENERAL PROVISIONS

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add to 1.2. the following Clause 1.2.3.1:

1.2.3.1 "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 all other work. Where details or conditions are indicated but started only, such details, or conditions shall be continued throughout the course or parts in which they occur and shall also apply to all other similar parts of the Work unless otherwise indicated or specifically noted. On all Drawings, figures shall take precedence over measurements by scale, and scaling is done at the Contractors own risk."

1.5 EXECUTION OF CONTRACT DOCUMENTS

Delete subparagraph 1.5.2 in its entirety and substitute the following:

1.5.2 "By the signing and delivery of this Contract, the Contractor acknowledges that he has fully acquainted himself with all provisions and requirements of the Contract Documents, that he has visited and inspected the job site and building area in which the work is to be performed, that he has satisfied himself as to the nature and location of the Work, including any

obstructions, amount of work, the general and local conditions, actual levels, the equipment and facilities needed preliminary to and during the prosecution of the Work and all other matters which can in any way affect the Work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with such information will not relieve him from the responsibility for successfully performing the Work. There shall be no claim allowed for additional compensation to Contractor based upon unanticipated or additional work unless Contractor can show to Owner's sole satisfaction that such unanticipated or additional work could not have been discovered by reasonable means prior to the bid."

ARTICLE 2; OWNER

2.1. GENERAL

Delete Subparagraph 2.1.2 in its entirety.

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete Subparagraph 2.2.1 in its entirety.

2.2.3 Add a new last sentence: "The Owner has endeavored to ascertain all pertinent information regarding site conditions and have, to the best of its ability furnished all such information to the Contractor. Such information is given, however, as being the best factual information available to the Owner, but is advisory only."

Delete subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 "The Contractor will be furnished, free of charge ten (10) copies of the drawings. Additional sets will be furnished at the cost of reproduction, postage and handling."

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

Delete subparagraph 2.4.1 in its entirety and substitute the following:

2.4.1 "If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of a written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the owner may have, correct such deficiencies. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner."

ARTICLE 3; CONTRACTOR

3.7 PERMITS, FEES AND NOTICES

3.7.1 Add a new last sentence: "However, the County of York has agreed to waive payment of those fees imposed by the County of York, Virginia."

Delete subparagraph 3.7.2 in its entirety and substitute the following:

3.7.2 "All work shall comply with all applicable federal, state and local regulations, codes and ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provision of this specification shall be construed as waiving any other rules, regulations or requirements of these authorities. The Contractor shall keep himself fully informed of any County regulation and all state and federal laws which in any manner effect the work herein specified. In any instance where these specifications or scope of work call for materials for construction of a better quality or larger size than required by the codes, the provision of the specifications and scope of work shall take precedence. Conversely, should the codes call for better quality or larger size, the codes shall govern."

Add a new subparagraph 3.7.5 as follows:

3.7.5 "The Owner will pay all permit and connection fees required for the work but the Contractor shall be responsible for securing same."

3.9 SUPERINTENDENT

Delete subparagraph 3.9.1 in its entirety and substitute the following:

3.9.1 "The Contractor shall assign a project manager to the work and have a competent superintendent or foreman satisfactory to the Owner on the work site at all times during progress of the work. The superintendent or foreman shall represent the Contractor and communications given to the superintendent or foreman shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing.

The Owner reserves the right to suspend the work until such time as a competent foreman or superintendent satisfactory to the Owner is assigned to the project. Contract time shall not be extended for such suspension nor shall the Contractor be entitled to any additional payment of any kind whatsoever as a result of such suspended work."

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

Add the following subparagraph 3.10.4:

3.10.4 "The Contractor shall submit an updated construction schedule monthly with his application for payment. The revised schedule will demonstrate a strategy for overcoming any

variances in the previous month's schedule in order to complete the project on time. Pay requests will not be reviewed unless accompanied by the updated schedule."

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Amend subparagraph 3.12.5 by adding new sub-paragraphs 3.12.5.1 and 3.12.5.2, as follows:

3.12.5.1 "Any Drawings, Schedules, and Catalog Data submitted without the Contractor's stamp of approval will not be considered by the Architect and will be returned to the Contractor."

3.12.5.2 "The Contractor shall be responsible for the satisfactory construction of all Work in accordance with the quantities, dimensions, and designs shown in the Contract documents and the furnishing of all materials necessary for the Work and required by the Contract Documents even if not indicated on the submittals that have been approved by the Architect."

Amend subparagraph 3.12.8 by adding the following to the end of the paragraph:

"Failure to so notify the Architect in writing of such deviations shall constitute just cause for rejection of samples and Shop Drawings, including all finished work resulting therefrom, at any time during the construction and up through the prescribed guarantee period. The Architect's approval of samples and Shop Drawings is made with the understanding that such Shop Drawings and samples conform with, and do not deviate from the Contract Documents unless Architect is so informed in writing at the time of submittal thereof."

3.14 CUTTING AND PATCHING

Add to 3.14 the following subparagraph 3.14.3:

3.14.3 "No cutouts, access doors or mechanical or electrical conduit or devices of any sort shall be installed in finished materials or areas other than in mechanical rooms, wall chases and shafts without specified prior approval of location, and without the prior submittal by Contractor to Owner of a sample of the proposed catalog cut. "

3.15 CLEANING UP

Delete subparagraph 3.15.1 and substitute the following:

3.15.1 "For the performance of the contract, the Contractor will be permitted to occupy such portions of the site as shown on the plans, or as permitted by Owner or his representative. A reasonable amount of tools, materials or equipment for construction purposes may be stored in such place, but not more than is necessary to avoid delays in construction. Excavated and waste materials, if any, shall be piled or stocked in such a way as to not interfere with spaces that may be designated to be left free and unobstructed, not to inconvenience other contractors or the Owner.

Upon completion of the work and before acceptance and final payment is made, the Contractor shall clean and remove from the site of work, surplus and discarded materials, temporary structures, the Contractor's tools, construction equipment, machinery, surplus materials and debris of every kind. Contractor shall leave the site of work in a neat and orderly condition equal to that which originally existed. Surplus and waste materials removed from the site of the work will be disposed of at a location satisfactory to the Owner."

3.16 ACCESS TO WORK

Add to 3.16. the following clause 3.16.2:

3.16.2 "The Owner and Architect shall have access to the Work at all times. The Contractor shall keep the Architect advised of the progress of the Project and shall provide opportunity for the Owner or his representative and the Architect to inspect each phase of the Work. The Contractor shall provide proper and safe facilities for such access and for inspection."

3.17 ROYALTIES, PATENTS AND COPYRIGHTS

Delete subparagraph 3.17.1 and substitute the following:

3.17.1 "The Contractor shall pay all royalties and license fees. The Contractor guarantees to save the Owner, its officers, agents and employees, harmless from liability of any nature or kind for use of any copyrighted or un-copyrighted composition, secret process, patented or unpatented invention, articles or appliances furnished or used in the performance of the contract or of which the Contractor is not the patentee, assignee or licensee and shall defend all such suits or claims. Contractor shall not be responsible for such 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 or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

This subparagraph 3.17.1 shall be deemed to be incorporated into any contract awarded as a consequence of this bid."

3.18 INDEMNIFICATION

Delete subparagraph 3.18.1 and substitute the following:

3.18.1 "Contractor and all subcontractors shall bear all loss, expense (including reasonable attorney's fees) and damage from any cause whatsoever arising out of, incidental to, or in connection with the performance of the contract and shall indemnify Owner, its agents, officers

and employees against and save Owner, its agents, officers and employees harmless from all claims, demands, and judgments made or recovered against Owner because of bodily injuries, including death, at any time resulting therefrom, and/or because of damage to property, from any cause whatsoever, arising out of, incidental to, or in connection with the performance of the contract whether or not due to any act of its or their employees, servants or agents and whether or not due to any act of omission or commission, including negligence, but excluding sole negligence of Owner, its agents, officers and employees. Compliance by the Contractor with the insurance provision hereof shall not relieve Contractor from liability under this provision.

Should Contractor, its employees, servants or agents and any subcontractors use any of Owner's equipment, tools, employees, or facilities, such will be gratuitous and Contractor and subcontractors shall release Owner its agents, officers and employees from and indemnify and save Owner, its agents, officers and employees harmless from and against any claims for property damage and/or personal injuries, including death, arising out of the use of any such equipment, tools, employees, or facilities, whether or not based upon the condition thereof or any alleged negligence of Owner in permitting the use thereof.

The Contractor, its employees, servants or agents and any subcontractors guarantees to save the Owner, its agents, officers or employees, harmless from liability of any nature or kind, for use of any copyrighted or un-copyrighted composition, secret process, patented or unpatented invention, articles or appliances furnished or used in the performance of the contract, or which the Contractor is not the patentee, assignee or licensee.

This subparagraph 3.18.1 shall be deemed to be incorporated into any contract awarded as a consequence of this bid.

ARTICLE 4; ADMINISTRATION OF THE CONTRACT

4.1 ARCHITECT

Add to 4.1.1 the following clause 4.1.1.1:

4.1.1.1 "Wherever the term "Architect" is used in the Contract Documents, it refers to Hudson + Associates Architects, PLLC and/or their duly authorized representatives."

Delete Subparagraphs 4.1.2 and 4.1.3.

4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

Delete subparagraph 4.2.12 and substitute the following:

4.2.12 "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."

4.3 CLAIMS AND DISPUTES

Delete Subparagraph 4.3.1 and substitute the following:

4.3.1 "Definition. A claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of the Contract Documents, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract but specifically does not include any Claim or demand arising for the first time after final payment is made. Claims must be made by written notice. The responsibility to substantiate claims shall rest with the party making the claim."

Delete Subparagraph 4.3.2 and substitute the following:

4.3.2 "TIME LIMIT ON CLAIMS.
a. Notice. Notice of a claim by either party must be given to the other party within thirty (30) calendar days after occurrence of the event giving rise to such Claim or within thirty (30) days after the Claimant should reasonably have known of the condition giving rise to the Claim, whichever is later. Notice of claim must be made by written notice. Failure to make claims within the time period specified in this subparagraph shall be deemed a waiver of the claim.
b. Documentation. Supporting documentation of the claim shall be submitted within sixty (60) calendar days of the event on which the claim is based. Failure to submit supporting documentation within sixty (60) days bars further pursuit of the claim.
c. Additional claim. An additional claim made after the initial claim had been implemented by change order will not be considered unless submitted in a timely manner."

4.3.7 CLAIMS FOR ADDITIONAL TIME.

Add the following to the end of subparagraph 4.3.7.1:

"Requests for extension of time based on delayed deliveries of materials will not be considered, except in Owner's sole and unreviewable discretion. Submission of a bid and the time of completion stated thereon shall be considered confirmation of Contractor's having verified delivery dates for required materials."

4.3.8 INJURY OR DAMAGE TO PERSONS OR PROPERTY

Delete subparagraph 4.3.8

4.4 RESOLUTION OF CLAIMS AND DISPUTES

Amend Subparagraph 4.4.4 by adding the following language at the end, as follows:

"If there is a Surety and there appears to be a possibility of a Contractor's default, the Architect may, but is not obligated to, notify the Surety and request the Surety's assistance in resolving the controversy. "

Delete Subparagraph 4.4.5 and substitute the following:

4.4.5 "The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties unless a Claim is submitted pursuant to Subsection 4.4.9 herein."

Delete subparagraph 4.4.6 in its entirety.

Add a new subparagraph 4.4.9 as follows:

4.4.9 "Any controversy or Claim by Owner or Contractor arising out of or related to the Contract, or the breach thereof, except for Claims which have been waived by the making and acceptance of final payment as provided in the Contract documents, may be submitted for review to the County School Board of York County, Virginia pursuant to the terms of Section 15.2-1243, et. seq. of the Code of Virginia (applied to the School Board *mutatis mutandis*) within ten (10) days of the date of the Architect's written decision issued pursuant to Subparagraph 4.4.5. Failure to file a Claim as provided for in this subparagraph within ten (10) days of the date of the Architect's decision, shall be deemed a waiver of further review of the Claim."

4.5 MEDIATION

Delete Paragraph 4.5 and all Subparagraphs thereof in their entirety.

4.6 ARBITRATION

Delete paragraph 4.6 and all Subparagraphs thereof in their entirety.

ARTICLE 5; SUBCONTRACTORS

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF WORK

Add the following Subparagraph 5.2.5:

5.2.5 "The Owner may revoke approval of any subcontractor only for good cause. Notice of such revocation of approval will be given in writing to the Contractor by the Owner and all work by said subcontractor shall immediately cease."

Add the following Subparagraph 5.2.6

5.2.6 "Contractor shall provide a statement in writing from each subcontractor that such subcontractor waives all rights to assert any claims, actual and/or consequential, against the Owner allegedly arising from or growing out of any delays in the work schedule or any failure of the Contractor to pay such subcontractor any sums owed by the Contractor to such subcontractor."

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

Delete Subparagraph 5.4.2 in its entirety.

ARTICLE 6; CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.2 MUTUAL RESPONSIBILITY

Add the following subparagraph 6.2.6:

6.2.6 "If any other Contractor or his subcontractors or their material suppliers shall suffer loss or damage through acts of omissions on the part of the Contractor, any subcontractor, and sub-subcontractor or any material man of any of the foregoing, the Contractor agrees to reimburse such other Contractor or his sub-contractor or material supplier to the extent that they may be entitled to reimbursement. If such other Contractor or subcontractor or his material supplier shall assert any claim against the Owner on account of any damage alleged to have been sustained, the Owner shall notify the Contractor and the Contractor shall indemnify and save the Owner harmless from and against loss, liability, claim, damage, fee, expense, including reasonable attorney's fees of any kind whatsoever arising out of or in any way connected with any such claim and Contractor shall defend at his own expense any suit in connection with any such claim, and if a judgment shall be rendered against the Owner in connection with any such claim, Contractor shall pay or satisfy any such judgment or claim and shall pay all costs, fees, expenses, disbursements and liabilities of whatsoever kind in connection therewith."

ARTICLE 7; CHANGES IN THE WORK

7.2 CHANGE ORDERS

Add the following Subparagraph 7.2.3

7.2.3 "Before any work under this Agreement shall qualify as additional work and made part of a change order, the Contractor shall notify the Owner and Architect in writing of his intention to

treat certain work, if performed, as additional work and his reasons therefore. If written notice is not given, no claim for additional work will be honored. Notice by Contractor shall not be construed as proving the validity of the claim."

Add the following Subparagraph 7.2.4

7.2.4 "Upon agreement that a change order is necessary by the Owner, Architect and Contractor, the parties will execute a written change order specifying the scope of work and the schedule for both work and additional payment, if any, agreed to by the parties. No oral agreement or directive regarding additional work or a change in terms of the Agreement by an employee of the Owner shall be binding on Owner."

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.6 In the first sentence, delete the words "a reasonable allowance for overhead and profit" and substitute "an allowance for overhead and profit in accordance with Clause 7.3.10.1 through 7.3.10.6 below."

Add the following Subparagraph 7.3.10:

7.3.10 " In Subparagraph 7.3.6, the allowance for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:

.1 For the Contractor, for Work performed by the Contractor's own forces, ten percent (10%) of the cost.

.2 For the Contractor, for Work performed by the Contractor's Subcontractor, five percent (5%) of the amount due the Subcontractor.

.3 For each Subcontractor or Sub-subcontractor involved, for Work performed by the Subcontractor's or Sub-subcontractor's own forces, ten percent (10%) of the cost.

.4 For each Subcontractor, for Work performed by the Subcontractor's Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractor.

.5 Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.6.

.6 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over $500.00 be approved without such itemization."

ARTICLE 9; PAYMENTS AND COMPLETION

9.3 APPLICATIONS FOR PAYMENT

Add the following clause 9.3.1.3 to 9.3.1:

9.3.1.3 "Until substantial completion, the Owner shall pay no more than ninety-five percent (95%) of the amount due the Contractor on account of progress payments."

Add the following Subparagraph 9.3.4

9.3.4 "All material and work covered by partial payments that thereafter becomes the sole property of Owner shall not be construed to relieve the Contractor from the sole responsibility for the safety and protection of all materials and work upon which payments have been made or the Contractor's responsibility of restoration or replacement of any damaged or stolen work or property or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract Documents."

9.7 FAILURE OF PAYMENT

Delete subparagraph 9.7.1

9.8 SUBSTANTIAL COMPLETION

Amend subparagraph 9.8.4 by adding the following:

"Nothing herein shall authorize the Architect to extend the date for final completion of the Work except as authorized in Article 7."

9.10 FINAL COMPLETION AND FINAL PAYMENT

Add the following to Subparagraph 9.10.2:

9.10.2 "(6) a record set of as-built drawings and specifications or manual. "

Add the following Subparagraph 9.10.2.1

9.10.2.1 "Within thirty (30) days after issuance of the final Certificate for Payment, upon acceptance of same by the Owner, and upon Contractor's compliance with the terms of Subparagraph 9.10.2 the Owner shall make final payment to the Contractor pursuant to Paragraph 9.10."

Delete Subparagraph 9.10.3

Delete Subparagraph 9.10.5 and substitute the following:

9.10.5 "Acceptance of final payment by the Contractor or sub-contractor or material supplier shall constitute a waiver and release of all Claims by that payee except those previously made in writing and pursued by the payee as required by the terms of the Contract Documents. Such Claims previously made must be identified by the payee as unsettled at the time of final application for payment."

Add Subparagraph 9.10.6 as follows:

9.10.6 "Contractor's obligation to perform the work and complete the project in accordance with the Contract Documents shall be absolute. Neither approval of any progress or final payment nor the issuance of a certificate of substantial completion, nor any payment by Owner to Contractor under the Contract Documents, nor any use or occupancy of the project or any part thereof by Owner, nor any act of acceptance by Owner, nor any failure to do so, nor the failure of Owner to file a Claim as set forth in the Contract Documents, nor any correction of defective work by Owner, shall constitute an acceptance of work not in accordance with the Contract Documents nor shall the same relieve the Contractor of responsibility for faulty materials or workmanship or operate to release the Contractor or his Surety from any obligation under the contract, the performance bond or the payment bond."

Add the following Subparagraph 9.10.7

9.10.7 "No Certificate for Payment issued by the Architect and no payment, final or otherwise, nor partial or entire use or occupancy of the Work by the Owner shall be an acceptance of any work or materials not in accordance with the Contract Documents nor shall the same relieve the Contractor of responsibility for faulty materials or workmanship or operate to release the Contractor or his Surety from any obligation under the Contract or the Performance and Payment Bonds. Any dispute of the Final Payment by the Contractor shall be resolved as a claim against the Owner and processed pursuant to Virginia Code Section 15.2-1243 et seq. and 22.1-122 applied to the Owner *mutatis mutandis*."

Add the following Paragraph 9.11 as follows:

9.11 LIQUIDATED DAMAGES

9.11.1 "Because time is of the essence and because the consequences of untimely completion of the Work cannot be quantified as of the date of this Agreement, the parties agree that the Contractor and the Contractor's Surety, if any, shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages, and not as a penalty, for each calendar day of delay until the Work is substantially complete Five Hundred U.S. Dollars ($500.00), and for each calendar day of delay until the Work is finally complete an additional Five Hundred U.S.

Dollars ($500.00) for a possible total of One Thousand U. S. Dollars ($1000.00) per calendar day of delay, and Contractor further agrees that Owner may deduct and retain such liquidated damages out of any money due Contractor under the terms of this Contract."

ARTICLE 10; PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

Add to 10.2.1 the following paragraph 10.2.1.4:

10.2.1.4 "Contractor's materials, tools, machinery, equipment, appliances, shoring, sheds and personal property of the Contractor's employees."

Add to 10.2.2 the following clause 10.2.2.1:

10.2.2.1 "The Contractor agrees in order that work be executed with the greater degree of safety:

(1) To comply with all laws, ordinances, and regulations regarding safety.

(2) To comply as applicable with the "Rules and Regulations Governing Construction Demolition and All Excavations" as adopted by the Safety Codes Commission of the Commonwealth of Virginia.

(3) To conform to all applicable provisions of the "Manual of Accident Prevention in Construction" published by the Association of General Contractor of America, Inc., latest edition.

(4) To comply with all applicable provisions of the "Occupational Safety and Health Act of 1970," as amended."

In subparagraph 10.2.5 delete the language within the parentheses.

Add the following Subparagraph 10.2.8 as follows:

10.2.8 "The Contractor shall to the greatest extent practicable secure the Work against weather, providing coverage or other protection of the Work against damage by wind or rain or other weather events. In the event Contractor shall fail to provide such protection, Contractor shall be obligated to correct or remediate all damages to the Work, and to any other structure or property of which the Work is a part or is affixed to the satisfaction of the Owner, by reason of (without limitation) inundation by water, damage from wind, or any damage resulting therefrom including without limitation the growth of mold as a result of exposure of the Work or any portions thereof to the elements. "

10.3 HAZARDOUS MATERIALS

Delete Subparagraph 10.3.2 in its entirety and in its place substitute the following:

10.3.2 "The Owner shall verify the presence or absence of the material or substances reported by the Contractor and, in the event such material or substance is found to be present, verify that it has been rendered harmless. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. The Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up."

Delete subparagraph 10.3.3 in its entirety.

Delete subparagraph 10.5 in its entirety.

ARTICLE 11; INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE
Add new subparagraphs 11.1.1.9 and 11.1.1.10, as follows:

11.1.1.9 Liability Insurance shall include all major divisions of coverage and be on a comprehensive basis including:

1. Premises Operations (including X, C, and U coverage as applicable).

2. Independent Contractor's Protective

3. Products and Completed Operations

4. Personal Injury Liability with Employment Exclusion deleted.

5. Contractual, including specified provision for Contractor's obligation under Paragraph 3.18.

6. Owned, non-owned and hired motor vehicles.

7. Broad Form Property Damage including Completed Operations."

11.1.1.10 "If the General Liability coverages are provided by a Commercial General Liability Policy on a claims-made basis, the policy date or Retroactive Date shall predate the Contract; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with Subparagraph 9.10.2."

Add the following Clause 11.1.2.1:

11.1.2.1 "The insurance required by Subparagraph 11.1.1 shall be written for not less that the following limits, or greater if required by law:

1. Worker's Compensation

(a) State: Statutory

(b) Applicable Federal (e.g., Longshoreman's) Statutory

(c) Employer's Liability: $100,000 per Accident

$100,000 Disease, Policy Limit

$500,000 Disease, Each Employee

2. Comprehensive or Commercial General Liability (including Premises Operations; Independent Contractor's Protective; Products and Completed Operations; Broad Form Property Damage):

(a) Bodily Injury:
$1,000,000 Each Occurrence
$1,000,000 Aggregate

(b) Property Damage:
$1,000,000 Each Occurrence
$1,000,000 Aggregate

(c) Products and Completed Operations to be maintained in full effect for one year after the date of final acceptance of the project by the Owner

$1,000,000 Aggregate

(d) Property Damage Liability Insurance shall provide X, C, and U coverage

(e) Broad Form Property Damage Coverage shall include Completed Operations.

3. Contractual Liability:

(a) Bodily Injury:

$1,000,000 Each Occurrence
$1,000,000 Aggregate

4. Personal Injury, with Employment Exclusion deleted:

$1,000,000 Aggregate

5. Business Auto Liability (including owned, non-owned and hired vehicles):

(a) Bodily Injury:

$1,000,000 Each Person
$1,000,000 Each Occurrence

(b) Property Damage:

$1,000,000 Each Occurrence

6. Umbrella Excess Liability:

$5,000,000 over primary insurance, Each Occurrence
$5,000,000 over primary insurance, Aggregate
$10,000 retention for self-insured hazards each occurrence."

11.1.3 Add the following sentence to Subparagraph 11.1.3:

"If this insurance is written on the Comprehensive General Liability policy form, the Certificates shall be AIA Document G705, Certificate of Insurance. If this insurance is written on a Commercial General Liability policy form, ACORD form 25S will be acceptable. The Contractor shall deliver certificates of insurance from carriers acceptable to the Owner specifying such limits, along with a proper endorsement naming the "County School Board of York County, Virginia, its Officers, Agents and Employees" as Additional Insured, with primary status, without participation from the Board's insurers" on applicable policy(s). The provisions of this paragraph shall be deemed included in the contract as if fully set out therein.

Further, the successful Contractor agrees they shall immediately notify, in writing, the Owner of any changes, modifications, and/or termination of any insurance coverages and/or policies required by the resulting contract."

11.2 OWNER'S LIABILITY INSURANCE

Delete subparagraph 11.2.1 in its entirety.

11.4 PROPERTY INSURANCE

Delete subparagraphs 11.4.1, 11.4.1.1, 11.4.1.2, 11.4.1.3, and 11.4.1.4, and substitute the following:

11.4.1 "Contractor or builder's risk insurance in the all-risk form shall be provided by the Contractor in a minimum amount of 100 per cent (100 %) of the Contract Sum covering damage to or loss of work performed under the Contract caused by fire, water, explosion, wind, lightening, vandalism, malicious mischief and any other similar casualty risk or peril. The insurance shall be payable to the Owner and the Contractor as their respective interests may appear. The Owner shall be named as an additional insured on the insurance policy and Contractor shall provide the certificate of insurance from a carrier acceptable to the Owner specifying such limit, along with the proper endorsement naming the "County School Board of York County, Virginia, its Officers, Agents and Employees" as Additional Insured, with primary status, without participation from the Board's insurers" in the insurance contract. Such insurance shall cover portions of the Work stored off site, and also portions of the Work in transit."

Delete Subparagraphs 11.4.2, 11.4.3, 11.4.4, 11.4.5, 11.4.6, 11.4.7, 11.4.8, 11.4.9 and 11.4.10.

11.5 PERFORMANCE BOND AND PAYMENT BOND

Delete Subparagraph 11.5.1 and substitute the following:

11.5.1 "The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder. Bonds shall be in the form specified in the Contract Documents with surety approved by the County Attorney. The cost of all bonds shall be included in the Contract sum. The amount of each bond shall be equal to 100 percent (100%) of the Contract sum. The bonds shall be maintained in full force and effect until final acceptance of the Work by the Owner however the Performance bond shall be in accordance with Sections 11.5.1.3 and 11.5.1.4 below. The Contractor will cause the Surety to agree to be bound by each and every provision in the Contract Documents."

11.5.1.1 "The Contractor shall deliver the required bonds to the Owner not later than the date of execution of the Contract or if the work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the work, submit evidence satisfactory to the Owner that such bonds will be furnished."

11.5.1.2 "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 the power of attorney."

11.5.1.3 "Whenever the Contractor shall be declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety shall be required to give written notice to the Owner, within seven (7) days after receipt of a declaration of default, of the Surety's election either to remedy the default or defaults promptly or to pay the Owner the penal sum of the bond, such payment to be made at the time of the notice, time being

of the essence. In the notice of election, the Surety shall indicate the date on which the remedy or performance will commence, and it shall then be the duty of the Surety to give prompt notice in writing to the Owner immediately upon completion of (a) the remedy and/or correction of each default, (b) the remedy and/or correction of each item of Work, (c) the finishing of each omitted item of Work, and (d) the performance of the Work.

However, Owner, at its option, may require the Surety to promptly proceed to remedy the default by proceeding or procuring others to proceed with completing the Agreement pursuant to its terms and conditions; and all reserves deferred payments and other funds provided by the Agreement to be paid to Contractor shall be paid to Surety at the same times and under the same conditions as by the terms of that Agreement such fund would have been paid to Contractor had the Agreement been performed by the Contractor; and Surety shall be entitled to such funds in preference to any assignee of Principal of any adverse claimant.

Notwithstanding the above, the Owner shall have the right, with the approval of the Surety which shall not be unreasonable withheld, to take over and assume completion of the Contract and Surety shall promptly pay the Owner the penal sum of the bond, such payment to be made at the time of the notice, time being of the essence.

The Surety shall not assert insolvency of the Contractor or Contractor's denial of default as justification for its failure to promptly remedy the default or defaults or to perform the Work."

11.5.1.4 "The Performance Bond shall also require the Contractor to make good at his own expense, work due to imperfect materials and workmanship for those periods of time as specified in Section 14.0 of IFB 1893 "GUARANTEE" following substantial completion of the project. The Surety on both bonds shall be a duly authorized Surety Company or Companies satisfactory to the Owner."

ARTICLE 13; MISCELLANEOUS PROVISIONS

13.6 INTEREST

Delete Subparagraph 13.6.1

13.7 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

Delete paragraph 13.7.1 and all subparagraphs thereof, in their entirety.

Add a new paragraph 13.8 as follows:

13.8 "EQUAL OPPORTUNITY

13.8.1 During the performance of this contract, the Contractor shall maintain policies of employment, in conformance with the provisions of the Federal Civil Rights Act of 1964, as

amended, as well as the Virginia Fair Employment Act of 1975, as amended, and Section 2.2-4311 of the Virginia Public Procurement Act, as follows:

13.8.1.1 The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin, age, disability, status as a service disabled veteran, or any other basis prohibited by Virginia law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

13.8.1.2 The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

13.8.1.3 Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

13.8.1.4 During the performance of this contract, the Contractor agrees to (i) provide a drug-free workplace for the Contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of this prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provision will be binding upon each subcontractor or vendor.

For the purpose of this subsection, a "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a Contractor in accordance with this subsection, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the Contract.

13.8.2 The contractor will include the provisions of the foregoing subparagraphs 13.8.1.1, 13.8.1.2, 13.8.1.3 and 13.8.1.4 in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

13.8.3 In accordance with Section 2.2-4343.1 of the Code of Virginia, et. seq., the Owner shall not (i) discriminate against a faith-based organization as defined in the Code of Virginia Section 2.2-4343.1 (B) on the basis of the organization's religious character or (ii) impose condition that (a) restrict the religious character of the faith-based organization, except as provided in subsection F of Section 2.2-4343.1 of the Code of Virginia, or (b) impair, diminish, or

discourage the exercise of religious freedom by the recipients of such goods, services or disbursements.

13.8.4 By signing this Contract, the Contractor certifies that it does not and will not, during the performance of this Contract, violate the provision of the Federal Immigration Reform and Control Act of 1986, as amended, which prohibits employment of illegal aliens."

ARTICLE 14; TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION OF THE CONTRACTOR

Delete Subparagraph 14.1.1.4

14.2 TERMINATION BY THE OWNER

14.2.2 In the first sentence, delete "upon certification by the Architect that sufficient cause exists to justify such action."

END OF SUPPLEMENTAL CONDITIONS SECTION

15.0 INSURANCE:

The Contractor shall carry insurance in the amounts specified in the Supplemental Conditions, ARTICLE 11 above, including the Contractual Liability assumed by the Contractor and prior to the commencement of any work shall deliver certificates of insurance from carriers acceptable to the Owner specifying such limits, along with a proper endorsement naming the "County School Board of York County, Virginia, its Officers, Agents and Employees" as Additional Insured on a primary basis (Form No. GL-20-10) on applicable policy(s) (such additional insured status shall be primary without participation by Owner's insurers). The provisions of this paragraph shall be deemed included in the contract as if fully set out therein.

Further, the successful Contractor agrees they shall immediately notify, in writing, the Owner of any changes, modifications, and/or termination of any insurance coverages and/or policies required by the resulting contract.

16.0 CONTRACTOR REGISTRATION:

If a contract is for seventy thousand dollars ($70,000) or more, of the total value of all construction, removal, repair or improvements undertaken by the bidder within any twelve month period is five hundred thousand dollars ($500,000) or more, the bidder is required under Title 54.1, Code of Virginia (1950), as amended, to be licensed as a "CLASS A CONTRACTOR." If a contract of fifteen hundred dollars ($1,500) or more but less than seventy thousand dollars ($70,000), the bidder is required to be licensed as a "CLASS B CONTRACTOR."

The bidder shall place on the outside of the envelope containing the bid and shall place in the bid over his signature whichever of the following notations is appropriate, inserting his Contractor License Number:

Licensed Class A Virginia Contractor No. _____ Class

Licensed Class B Virginia Contractor No. _____ Class

If a bidder/offeror shall fail to obtain this license prior to submission of bid, the bid shall not be considered.

17.0 SCC REGISTRATION:

If Contractor is organized as a stock or nonstock corporation, a limited liability company, a business trust, or a limited partnership, or is registered as a registered limited liability partnership, Contractor must be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 of the Code of Virginia, or as otherwise required by law. If Contractor allows its existence to lapse, or its certificate of authority or registration to transact business in the Commonwealth of Virginia to expire, or be revoked or cancelled, such will be deemed an act of default enabling Owner to all remedies for default, including but not limited to revocation of this Contract.

18.0 CONTRACTOR QUALIFICATIONS:

The General Contractor must have a minimum of eight (8) years' experience and must have completed three (3) school projects of a similar size and scope within the past five (5) years. Immediately after identifying the apparent low bidder that Contractor shall submit the names, addresses and phone numbers of the contact person, for each of these similar projects. These references may be used in determining the most qualified bidder irrespective of the low bid.

19.0 CERTIFICATIONS: In accordance with Virginia Code Section 22.1-296.1, all contractors shall certify that they or any of their employees who will provide services under any resulting contract and who will be in direct contact with York County School Division students:

1) have not been convicted of a felony or any offense involving the sexual molestation or physical or sexual abuse or rape of a child.

For purposes of this requirement, "direct contact with students" means being in the presence of students on school property during regular school hours or during school-sponsored activities.

Any person making a materially false statement regarding any such offense shall be guilty of a Class 1 misdemeanor and, upon conviction, the fact of such conviction shall be grounds for the revocation of the contract to provide such services and, when relevant, the revocation of any license required to provide such services.

The Company Certification should be completed in its entirety. Any person, employee, subcontractor, agent, officer, owner or shareholder of the corporation, firm or partnership who will provide services under a resulting contract and who will be in direct contact with York County School Division students shall meet the certification requirements.

Please note that this certification shall be binding throughout the contract period and the contractor shall provide the York County School Division with immediate notice of any event which renders their certifications untrue.

20.0 BID FORM/BID SCHEDULE:

TO: Central Purchasing
County of York, Virginia
120 Alexander Hamilton Blvd./P O Box 532
Yorktown, VA 23690

FROM: (Bidder's Name & Address)
_____
_____
_____

The undersigned, having read and understood the Bidding Documents, and having visited the site and become familiar with local conditions under which the Work is to be performed, proposes to execute the Work described in the Contract Documents in accordance with the Bidding Documents based on the materials, equipment and systems required by the Bidding Documents, without exception, for the following amount(s):

BID SCHEDULE:
In accordance with the specifications, terms and conditions, and related documents herein, the bidder agrees to provide all labor, supervision, materials, tools, equipment, warranties, and insurance, to the total sum of:

BASE SUM ($_____)

_____

BID ALTERNATE #1 ($_____)

_____

a closed loop geothermal variable refrigerant flow AC system, mechanical and plumbing systems in support thereof with a separate roof ventilating unit to provide the outside air requirement.

BID ALTERNATE #2 ($_____)

_____

the enclosure of an existing 518 SF breezeway between the existing building and the detached gymnasium.

RECEIPT OF ADDENDA

Bidder acknowledges receipt of the following addenda and agrees the requirements thereof are included in this proposal:

Addenda #	Date	Date Received

21.0 COMPLETION DATE:

The Contractor shall have access to the site commencing with the Notice to Proceed. **All work must be substantially completed by August 15, 2014. Final Completion shall be no later than September 15, 2014.**

22.0 AGREEMENT TO EXECUTE CONTRACT:
Within 60 days after the opening of Bids or any time thereafter before withdrawing this Bid, the Undersigned will, within ten (10) days after receipt of written Notice of Acceptance of this Bid, execute and deliver to the Owner the Contract Agreement Forms, together with Performance and Payment Bonds as required by the Contract Documents and Bids as accepted. The Undersigned designates as his office to which Notice of Acceptance shall be mailed or otherwise delivered:

(Name) _____

(Address) _____

_____

Virginia Contractors License Number:_____

Bidder is (Check one): Individual ( ) Partnership ( ) Corporation ( )

Residence of Bidder (if individual): _____

Name of Partners (if partnership): _____

State of Incorporation (if corporation): _____

SIGNATURE:
By: _____ Corporate Seal

Print Name of Bidder: _____

Title: _____

Date of Bid: _____

23.0 CONTRACTOR DATA:
All bidders must complete this section and return it with your bids, in order for Owner to complete the evaluation of the bids.

23.1 Experience/Years in Business:
Indicate the length of time you have been in business providing this type of commodity and service: ____years ____months.

23.2 References:

Indicate below a listing of at least three (3) different references where you have provided this type of equipment and service recently. Include the dates equipment and services were provided and the name and address of the person we have your permission to contact.

CLIENT	DATE	ADDRESS	PERSON TO CONTACT AND PHONE NUMBER

SAMPLE CONTRACT FORM
SERVICES CONTRACT

Agreement No. _____

This AGREEMENT, dated this _____ day of _____, 2013, is by and between the COUNTY SCHOOL BOARD OF YORK COUNTY, VIRGINIA (a political subdivision of the Commonwealth of Virginia); hereinafter called the Owner; and _____ (a corporation organized and existing under the laws of the Commonwealth of Virginia); hereinafter called the Contractor.

WITNESSETH: The Owner and Contractor, for the consideration stated herein, agree as follows:

Scope of Work:
The Contractor shall perform all required work and shall provide and furnish all labor, materials, necessary tools, expendable equipment and utility and transportation service and all else required to complete:

> SEAFORD ELEMENTARY SCHOOL SIX CLASS ROOM ADDITION IN ACCORDANCE WITH INVITATION FOR BIDS (IFB) NO. 1893 AND THE PROJECT MANUAL entitled "Addition to Seaford Elementary School York County School Division" prepared by Hudson & Associates Architects, dated September 16, 2013.

all in strict accordance with the Specifications, including any and all Addenda, and in strict compliance with the Contract Documents hereinafter enumerated.

It is understood and agreed that said labor, materials, tools, equipment and service shall be furnished and said work performed and completed under the direction and supervision of the Contractor and subject to the approval of the Owner or its authorized representative.

Guarantee:
All materials and equipment furnished by the Contractor for use in the roof work portion of the Seaford Elementary School addition and all work involved in said roof work portion of the Seaford Elementary School addition included in this Contract shall be and the same are hereby guaranteed by the Contractor free from defects owing to faulty materials or workmanship for a period of two (2) years after date of substantial completion of the work. All such materials and equipment, furnished by the Contractor and all such work involved in the roof work portion of the Seaford Elementary School addition included in this Contract which proves defective, by reason of faulty material or workmanship within said period of two (2) years, shall be replaced by the Contractor free of cost to the Owner.

All other materials and equipment, furnished by the Contractor, and all other work involved in this Contract shall be and the same are hereby guaranteed by the Contractor free from defects owing to faulty materials or workmanship for a period of one (1) year after date of substantial completion of the work. All other materials and equipment, furnished by the Contractor, and all other work involved in

this Contract which proves defective, by reason of faulty material or workmanship within said period of one (1) year, shall be replaced by the Contractor free of cost to the Owner.

Nothing herein shall be deemed a waiver of any other available remedy for contract default, or as a waiver of any applicable statutory limitations period, nor as a waiver of any other applicable warranty period.

THE BID SCHEDULE OF THE SUCCESSFUL BIDDER
SHALL BE CONFORMED AND INSERTED HEREIN
TO BECOME A PART OF THE COMPLETED CONTRACT DOCUMENTS

Payments:
The Owner will pay to the Contractor in the manner and at such times as set forth in Section 5.7 of IFB 1893, such amounts as required by the Contract Documents. Unless otherwise provided, the Owner will make payment to the Contractor within thirty (30) calendar days after receipt of the Certificates for Payment from the Architect and following acceptance of same by the Owner.

Liquidated Damages:
Because time is of the essence and because the consequences of untimely completion of the Work cannot be quantified as of the date of this Agreement, the parties agree that the Contractor and the Contractor's surety, if any, shall be liable for and shall pay the Owner the sums hereinafter stipulated as liquidated damages, and not as a penalty, for each calendar day of delay until the Work is substantially complete Five Hundred U.S. Dollars ($500.00), and for each calendar day of delay until the Work is finally complete an additional Five Hundred U.S. Dollars ($500.00) for a possible total of One Thousand U. S. Dollars ($1000.00) per calendar day of delay, and Contractor further agrees that Owner may deduct and retain such liquidated damages out of any money due Contractor under the terms of this Contract.

Time:
The undersigned Contractor agrees to commence work within (15) calendar days after the date of Notice to Proceed and further agrees to complete the Contract Work within the following specified time limits:

> **All work must be substantially completed by August 15, 2014. Final Completion shall be no later than September 15, 2014** following issuance of a written notice to proceed.

THIS AGREEMENT SHALL BE BINDING UPON ALL PARTIES HERETO AND THEIR RESPECTIVE HEIRS, EXECUTORS, ADMINISTRATORS, SUCCESSORS, AND ASSIGNS.

Component Parts of the Contract:

This Contract consists of the following component parts, all of which are hereby made a part hereof as if herein set out in full:

1. Advertisement for Bids
2. Invitation For Bids (IFB #1893), and any Exhibits, attachments or drawings thereto
3. Information for Bidders as incorporated into IFB 1893
4. Project Manual prepared by Hudson & Associates Architects, dated September 16, 2013 entitled "Addition to Seaford Elementary School York County School Division" including all specifications and schedules contained therein.
5. General Conditions of the Contract for Construction (AIA Document A201, 1997 edition) as modified by the Supplemental Conditions to AIA Document A201, 1997 edition and IFB 1893.
6. Supplemental Conditions To AIA Document A201
7. Contractor's Qualification Statement (AIA Document A305 – 1986)
8. Bid Proposal
9. Contract (this document)
10. Bid Bond
11. Payment Bond
12. Performance Bond
13. Certificate of Insurance
14. Contractor's License
15. Notice of Award
16. Notice to Proceed
17. Change Orders (if any)
18. Other Documents as may be required by law or appended hereto
19. Specifications/Project Manual Architects, Plans and Drawings listed therein
20. Warranties as specified in the Project Manual
21. Compliance Certificate
22. Company Certification in accordance with Virginia Code § 22.1-296.1

23. Addenda:

No. _____, dated _____, 2012

No. _____, dated _____, 2012

No. _____, dated _____, 2012

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed as of the day and year first above written in (4) counter-parts each of which shall for all purposes be deemed an original.

ATTEST:

	COUNTY SCHOOL BOARD OF YORK COUNTY, VA
NAME	OWNER
	BY
TITLE	TITLE: SUPERINTENDENT OF SCHOOLS

ATTEST:

NAME	CONTRACTOR
TITLE	BY
	TITLE

CONTRACTOR'S ADDRESS:

CONTRACTOR'S FEDERAL I. D. NO.:

APPROVED AS TO FORM:

COUNTY ATTORNEY

RESERVED FOR CERTIFICATE OF INSURANCE,
AND ADDITIONAL INSURED FORM GL-20-10
OR OTHER SATISFACTORY EVIDENCE OF REQUIRED COVERAGE

SAMPLE CONTRACT FORMS

PERFORMANCE BOND

Bond No._____

Amount: $_____

KNOW ALL PERSONS BY THESE PRESENTS, that
_____ _____of
_____
_____, hereinafter called the Contractor and _____ a corporation duly organized and existing under and by virtue of the laws of the State of _____, hereinafter called the Surety, and authorized to transact business within the Commonwealth of Virginia as the Surety, are held and firmly bound unto _____ as Owner, in the sum of _____dollars ($_____), lawful money of the United States of America, for payment of which, well and truly be made to the Owner, the Contractor and the Surety bind themselves and each of their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents as follows:

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the Contractor has executed and entered into a certain Agreement, hereto attached, with the Owner dated _____, 20____, for:

> SEAFORD ELEMENTARY SCHOOL SIX CLASSROOM ADDITION IN ACCORDANCE WITH INVITATION FOR BIDS (IFB) NO. 1893 AND PROJECT MANUAL "Seaford Elementary School Six Class Room Addition," prepared by Hudson & Associates Architects, and dated September 16, 2013.

NOW THEREFORE, if the Contractor, and its successors and assigns, shall at all times duly, promptly, and faithfully perform the Work and any alteration in or addition to the obligations of the Contractor arising thereunder, including the matter of infringement, if any, of patents or other proprietary rights, and shall assure all guarantees against defective workmanship and materials, including the guarantee period following substantial completion by the Contractor and comply with all the covenants therein contained in the Specifications, Drawings, and other Contract Documents required to be performed by the Contractor, in the manner and within the times provided in the Agreement, and shall fully indemnify and save harmless the Owner from all costs and damage which it may suffer by reason or failure to do so, and shall fully reimburse and repay it all outlay and expenses which it may incur in making good any default, and reasonable counsel fees incurred in the prosecution of or defense of any action arising out of or in connection with any such default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that the Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract Documents or to the Work to be performed thereunder, or payment thereunder before the time required therein, or waiver of any provision thereof, or assignment, subletting or transfer thereof or any part thereof, shall in any way affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration, addition to the terms of the Contract Documents or any such payment, waiver, assignment, subcontract or transfer.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

Whenever the Contractor shall be declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety shall be required to give written notice to the Owner, within seven (7) days after receipt of a declaration of default, of the Surety's election either to remedy the default or defaults promptly or to pay the Owner the penal sum of the bond, such payment to be made at the time of the notice, time being of the essence. In the notice of election, the Surety shall indicate the date on which the remedy or performance will commence, and it shall then be the duty of the Surety to give prompt notice in writing to the Owner immediately upon completion of (a) the remedy and/or correction of each default, (b) the remedy and/or correction of each item of Work, (c) the finishing of each omitted item of Work, and (d) the performance of the Work.

However, Owner, at its option, may require the Surety to promptly proceed to remedy the default by proceeding or procuring others to proceed with completing the Agreement pursuant to its terms and conditions; and all reserves deferred payments and other funds provided by the Agreement to be paid to Contractor shall be paid to Surety at the same times and under the same conditions as by the terms of that Agreement such fund would have been paid to Contractor had the Agreement been performed by the Contractor; and Surety shall be entitled to such funds in preference to any assignee of Principal of any adverse claimant.

Notwithstanding the above, the Owner shall have the right, with the approval of the Surety which shall not be unreasonable withheld, to take over and assume completion of the Contract and Surety shall promptly pay the Owner the penal sum of the bond, such payment to be made at the time of the notice, time being of the essence.

The Surety shall not assert insolvency of the Contractor or Contractor's denial of default as justification for its failure to promptly remedy the default or defaults or to perform the Work.

IN WITNESS WHEREOF, all above parties bounded together have executed this instrument this ____ day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR

_____

By:_____(Seal)

Name:_____

Title: _____

_____
Attest

SURETY

_____

By:_____(Seal)

_____
Attest

APPROVED AS TO FORM:_____, 20____

_____
OWNER

NOTE: Date of Bond shall not be prior to the date of the Agreement. If the Contractor is a partnership, all partners shall execute the Bond.

IMPORTANT: The Surety named on this Bond shall be one who is licensed to conduct business in the Commonwealth of Virginia, and named in the current list of Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All Bonds signed by an agent shall be accompanied by a certified copy of the authority to act for the Surety at the time of signing of this Bond.

PAYMENT BOND

Bond No._____

Amount: $_____

KNOW ALL PERSONS BY THESE PRESENTS, that _____ _____of_____ __ _____hereinafter called the Contractor and _____ a corporation duly organized and existing under and by virtue of the laws of the State _____, hereinafter called the Surety, and authorized to transact business within the Commonwealth of Virginia as the Surety, are held and firmly bound unto _____ as Owner, in the sum of_____ dollars ($_____), lawful money of the United States of America, for payment of which, well and truly be made to the Owner, the Contractor and the Surety bind themselves and each of their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents as follows:

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the Contractor has executed and entered into a certain Agreement, hereto attached, with the Owner dated _____, 20___, for:

> SEAFORD ELEMENTARY SCHOOL SIX CLASSROOM ADDITION IN ACCORDANCE WITH INVITATION FOR BIDS (IFB) NO. 1893 AND PROJECT MANUAL "Seaford Elementary School Six Class Room Addition," prepared by Hudson & Associates Architects, and dated September 16, 2013

NOW THEREFORE, if the Contractor shall promptly make payments to all persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the Work provided for in the Agreement, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, repairs on machinery, equipment, and tools consumed, used or rented in connection with the construction of the Work, and all insurance premiums on the Work, and for all labor performed in the Work, whether by Subcontractor or otherwise, then this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that the Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract Documents or to the Work to be performed thereunder, shall in any way affect its obligation on this Bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract Documents.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, all above parties bounded together have executed this instrument this ____ day of _____, 20___, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR

By:_____(Seal)

Name:_____

Title:_____

_____
Attest

SURETY

_____

By: _____(Seal)

_____
Attest

APPROVED AS TO FORM:_____, 20_____

_____
OWNER

NOTE: Date of Bond shall not be prior to the date of the Agreement. If the Contractor is a partnership, all partners shall execute the Bond.

IMPORTANT: The Surety named on this Bond shall be one who is licensed to conduct business in the Commonwealth of Virginia, and named in the current list of Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All Bonds signed by an agent shall be accompanied by a certified copy of the authority to act for the Surety at the time of signing of this Bond.

T A B L E O F C O N T E N T S

AIA® Document A201™ – 1997

General Conditions of the Contract for Construction

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

THE OWNER:
(Name and address)

THE ARCHITECT:
(Name and address)

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

This document has been approved and endorsed by The Associated General Contractors of America

TABLE OF ARTICLES

INDEX
(Numbers and Topics in Bold are Section Headings)

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents consist of the Agreement between Owner and Contractor (hereinafter 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 do not include other documents such as bidding requirements (advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or portions of Addenda relating to bidding 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 Architect and Contractor, (2) between the Owner and a Subcontractor or Sub-subcontractor, (3) between the Owner and Architect or (4) between any persons or entities other than the Owner and Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 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 the Owner or by separate contractors.

§ 1.1.5 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.

§ 1.1.6 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.

§ 1.1.7 THE PROJECT MANUAL

The Project Manual is a volume assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

§ 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.

§ 1.2.2 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 which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 CAPITALIZATION

§ 1.3.1 Terms capitalized in these General Conditions include those which 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

§ 1.4.1 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 EXECUTION OF CONTRACT DOCUMENTS

§ 1.5.1 The Contract Documents shall be signed by the Owner and Contractor. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

§ 1.5.2 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.

§ 1.6 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.6.1 The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect or the Architect's consultants, and unless otherwise indicated the Architect and the Architect's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect, on request, upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' copyrights or other reserved rights.

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 shall 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 Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 The Owner shall, at the written request of the Contractor, prior to commencement of the Work and thereafter, furnish to the Contractor reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. Furnishing of such evidence shall be a condition precedent to commencement or continuation of the Work. After such evidence has been furnished, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees, including those required under Section 3.7.1, which are the responsibility of the Contractor under the Contract Documents, 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.

§ 2.2.3 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.

§ 2.2.4 Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness. Any other information or services relevant to the Contractor's performance of the Work under the Owner's control shall be furnished by the Owner after receipt from the Contractor of a written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals as are reasonably necessary for execution of the Work.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

§ 2.3.1 If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or persistently fails to carry out Work in accordance with 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.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

§ 2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a three-day period. If the Contractor within such three-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

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 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 obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Since the Contract Documents are complementary, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, 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. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect as a request for information in such form as the Architect may require.

§ 3.2.2 Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect, but 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. The

Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations, but any nonconformity discovered by or made known to the Contractor shall be reported promptly to the Architect.

§ 3.2.3 If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect in response to the Contractor's notices or requests for information pursuant to Sections 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Sections 4.3.6 and 4.3.7. If the Contractor fails to perform the obligations of Sections 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect.

§ 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, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and 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 written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any resulting loss or damage.

§ 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 Work 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 The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

§ 3.5 WARRANTY

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

§ 3.6.1 The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor which 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 AND NOTICES

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

§ 3.7.2 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations. However, if the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate Modification.

§ 3.7.4 If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 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, 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 but not in the allowances;

.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 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner in sufficient time to avoid delay in the Work.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare and keep current, for the Architect's approval, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows the Architect reasonable time to review submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

§ 3.11.1 The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to record field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work.

§ 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 which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor may be returned by the Architect without action.

§ 3.12.6 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.

§ 3.12.7 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 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 requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing 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 Architect on previous submittals. In the absence of such written 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 which 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. 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 cause such services or certifications to be provided by a properly 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 and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

§ 3.13 USE OF SITE

§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 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.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's 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 or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

§ 3.16 ACCESS TO WORK

§ 3.16.1 The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

§ 3.17.1 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 and Architect harmless from loss on account thereof, but shall not be responsible for such 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 or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered by Project Management Protective Liability insurance purchased by the Contractor in accordance with Section 11.3, the Contractor shall indemnify and hold harmless the Owner, Architect, 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), but only to the extent caused by the 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 which 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.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

§ 4.1 ARCHITECT

§ 4.1.1 The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

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

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a new Architect against whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the former Architect.

§ 4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Section 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 4.2.2 The Architect, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations (1) to become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed, (2) to endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if the Work 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. The Architect will neither have control over or charge of, nor be responsible 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, except as provided in Section 3.3.1.

§ 4.2.3 The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the

Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect will have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 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 with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals 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 Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, 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.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

§ 4.2.10 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 duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

§ 4.2.12 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 initial 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.

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

§ 4.3 CLAIMS AND DISPUTES

§ 4.3.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of 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. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 4.3.2 Time Limits on Claims. Claims by either party must 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. Claims must be initiated by written notice to the Architect and the other party.

§ 4.3.3 Continuing Contract Performance. Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Section 9.7.1 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.

§ 4.3.4 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which 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, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if 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 an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect 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 so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the Architect has given notice of the decision. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Section 4.4.

§ 4.3.5 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.6.

§ 4.3.6 If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with this Section 4.3.

§ 4.3.7 Claims for Additional Time

§ 4.3.7.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. 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.

§ 4.3.7.2 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.

§ 4.3.8 Injury or Damage to Person or Property. If either party to the Contract 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, written notice of such 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.

§ 4.3.9 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 4.3.10 Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 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 mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 4.3.10 shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 4.4 RESOLUTION OF CLAIMS AND DISPUTES

§ 4.4.1 Decision of Architect. Claims, including those alleging an error or omission by the Architect but excluding those arising under Sections 10.3 through 10.5, shall be referred initially to the Architect for decision. An initial decision by the Architect shall be required as a condition precedent to mediation, arbitration or litigation of all Claims between the Contractor and Owner arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Architect with no decision having been rendered by the Architect. The Architect will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 4.4.2 The Architect will review Claims and within ten days of the receipt of the 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 Architect is unable to resolve the Claim if the Architect lacks sufficient information to evaluate the merits of the Claim or if the Architect concludes that, in the Architect's sole discretion, it would be inappropriate for the Architect to resolve the Claim.

§ 4.4.3 In evaluating Claims, the Architect 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 Architect in rendering a decision. The Architect may request the Owner to authorize retention of such persons at the Owner's expense.

§ 4.4.4 If the Architect 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 such request, and shall either provide a response on the requested supporting data, advise the Architect when the response or supporting data will be furnished or advise the Architect that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Architect will either reject or approve the Claim in whole or in part.

§ 4.4.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefor and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties but subject to mediation and arbitration.

§ 4.4.6 When a written decision of the Architect states that (1) the decision is final but subject to mediation and arbitration and (2) a demand for arbitration of a Claim covered by such decision must be made within 30 days after the date on which the party making the demand receives the final written decision, then failure to demand arbitration within said 30 days' period shall result in the Architect's decision becoming final and binding upon the Owner and Contractor. If the Architect renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence, but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.

§ 4.4.7 Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect or 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 Architect or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 4.4.8 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 prior to resolution of the Claim by the Architect, by mediation or by arbitration.

§ 4.5 MEDIATION

§ 4.5.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 4.3.10, 9.10.4 and 9.10.5 shall, after initial decision by the Architect or 30 days after submission of the Claim to the Architect, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.

§ 4.5.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable 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.

§ 4.5.3 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.

§ 4.6 ARBITRATION

§ 4.6.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 4.3.10, 9.10.4 and 9.10.5, shall, after decision by the Architect or 30 days after submission of the Claim to the Architect, be subject to arbitration. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Section 4.5.

§ 4.6.2 Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect. The demand for arbitration shall be filed in writing with the other party to the Contract and with the American Arbitration Association, and a copy shall be filed with the Architect.

§ 4.6.3 A demand for arbitration shall be made within the time limits specified in Sections 4.4.6 and 4.6.1 as applicable, and in other cases within a reasonable time after the Claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Section 13.7.

§ 4.6.4 **Limitation on Consolidation or Joinder.** No arbitration arising out of or relating to the Contract shall include, by consolidation or joinder or in any other manner, the Architect, the Architect's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Architect, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Contractor or a separate contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a Claim not described therein or with a person or entity not named or described therein. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 4.6.5 **Claims and Timely Assertion of Claims.** The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 4.6.6 **Judgment on Final Award.** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

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 a separate contractor or subcontractors of a separate contractor.

§ 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 or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly 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 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 or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner 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 change a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitute.

§ 5.3 SUBCONTRACTUAL RELATIONS

§ 5.3.1 By appropriate agreement, written where legally required for validity, 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, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner 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 which 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.

§ 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:

.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 which the Owner accepts by notifying the Subcontractor and Contractor in writing; and

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

§ 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.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE 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 to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Section 4.3.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor 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 and separate 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 or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

§ 6.2.4 The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor 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

§ 6.3.1 If a dispute arises among the Contractor, separate 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, the Owner may clean up and the Architect will allocate the cost among those responsible.

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.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; 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, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect, stating their agreement upon all of the following:

.1 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.

§ 7.2.2 Methods used in determining adjustments to the Contract Sum may include those listed in Section 7.3.3.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner 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.

§ 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 7.3.6.

§ 7.3.4 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect 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.

§ 7.3.5 A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor 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.

§ 7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the Architect 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, a reasonable allowance for overhead and profit. In such case, and also under Section 7.3.3.3, the Contractor

shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.6 shall be limited to the following:

.1 costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.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;

.4 costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and

.5 additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.7 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the 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.

§ 7.3.8 Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by a Change Order indicating the parties' agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Architect will make an interim determination for purposes of monthly certification for payment for those costs. That 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 4.

§ 7.3.9 When the Owner and Contractor agree with the determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

§ 7.4 MINOR CHANGES IN THE WORK

§ 7.4.1 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

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 unless otherwise specifically defined.

§ 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, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 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. Unless the date of commencement is established by the Contract Documents or a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 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 an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending mediation and arbitration, or by other causes which the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Section 4.3.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

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.

§ 9.2 SCHEDULE OF VALUES

§ 9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.8, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Such applications may not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends 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. 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 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 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, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations 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 Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the 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 material 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.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The 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 previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from 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 for labor, materials or equipment;

.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

.5 damage to the Owner or another 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; or

.7 persistent failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect has issued a 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 Architect.

§ 9.6.2 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such 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 Architect 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 Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Payment to material 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 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

§ 9.7.1 If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by arbitration, then the Contractor may, upon seven additional days' written notice to the Owner 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 shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 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 that the Owner can occupy or utilize the Work for its intended use.

§ 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 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 accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect 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 Contractor's 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 to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall 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 such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such 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.

§ 9.9 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 as required under Section 11.4.1.5 and authorized by public authorities having jurisdiction over the Work. 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 shall 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.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, 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 receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of 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 Architect's final 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.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (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 and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial 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 and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, 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. If such lien 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 such lien, including all costs and reasonable attorneys' fees.

§ 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 Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed 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 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 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.

§ 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; or

.3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material 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

§ 10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 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 or the Contractor's Subcontractors or Sub-subcontractors; and

.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.

§ 10.2.2 The Contractor shall give notices and comply with applicable laws, ordinances, rules, 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 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 owners and users of adjacent sites and utilities.

§ 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.

§ 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 and 10.2.1.3 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 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either 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 and Architect.

§ 10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

§ 10.3 HAZARDOUS MATERIALS

§ 10.3.1 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 report the condition to the Owner and Architect in writing.

§ 10.3.2 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 verify that it has been rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect will promptly reply to the Owner in

writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. The Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up, which adjustments shall be accomplished as provided in Article 7.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, 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 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) and provided that such damage, loss or expense is not due to the sole negligence of a party seeking indemnity.

§ 10.4 The Owner shall not be responsible under Section 10.3 for materials and substances brought to the site by the Contractor unless such materials or substances were required by the Contract Documents.

§ 10.5 If, without negligence on the part of the Contractor, the Contractor is held liable 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 indemnify the Contractor for all cost and expense thereby incurred.

§ 10.6 EMERGENCIES

§ 10.6.1 In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, 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 Section 4.3 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;

.2 claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

.3 claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

.4 claims for damages insured by usual personal injury liability coverage;

.5 claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

.6 claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

.7 claims for bodily injury or property damage arising out of completed operations; and

.8 claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until date of final payment and termination of any coverage required to be maintained after final payment.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written

notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Section 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

§ 11.2 OWNER'S LIABILITY INSURANCE

§ 11.2.1 The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROJECT MANAGEMENT PROTECTIVE LIABILITY INSURANCE

§ 11.3.1 Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the Contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage, and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Sections 11.1.1.2 through 11.1.1.5.

§ 11.3.2 To the extent damages are covered by Project Management Protective Liability insurance, the Owner, Contractor and Architect waive all rights against each other for damages, except such rights as they may have to the proceeds of such insurance. The policy shall provide for such waivers of subrogation by endorsement or otherwise.

§ 11.3.3 The Owner shall not require the Contractor to include the Owner, Architect or other persons or entities as additional insureds on the Contractor's Liability Insurance coverage under Section 11.1.

§ 11.4 PROPERTY INSURANCE

§ 11.4.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.4 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.4.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's and Contractor's services and expenses required as a result of such insured loss.

§ 11.4.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance which will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.4.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.4.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.4.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.4.2 **Boiler and Machinery Insurance**. The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.4.3 **Loss of Use Insurance**. The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.4.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.4.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.4.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.4.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.4. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.4.7 **Waivers of Subrogation**. 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, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, 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 covered by property insurance obtained pursuant to this Section 11.4 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.4.8 A loss insured under Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.4.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.4.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or in accordance with an arbitration award in which case the procedure shall be as provided in Section 4.6. If after such loss no other

special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.4.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved as provided in Sections 4.5 and 4.6. The Owner as fiduciary shall, in the case of arbitration, make settlement with insurers in accordance with directions of the arbitrators. If distribution of insurance proceeds by arbitration is required, the arbitrators will direct such distribution.

§ 11.5 PERFORMANCE BOND AND PAYMENT BOND

§ 11.5.1 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.

§ 11.5.2 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 permit a copy to be made.

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 Architect's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect, be uncovered for the Architect's examination 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 which the Architect has not specifically requested to examine prior to its being covered, the 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, correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

§ 12.2.1.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections and compensation for the 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 one 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 an 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 written 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 one-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 that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-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 performance of the Work.

§ 12.2.2.3 The one-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 which 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, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work which 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 which the Contractor might have under the Contract Documents. Establishment of the one-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.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

§ 12.3.1 If the Owner prefers to accept Work which 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

§ 13.1.1 The Contract shall be governed by the law of the place where the Project is located.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect 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 such 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 an institutional lender providing construction financing for the Project. In such event, the lender shall assume the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

§ 13.3.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 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.

§ 13.4.2 No action or failure to act by the Owner, 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 there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. 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 Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The

Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

§ 13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the 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 Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 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 Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 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 Architect.

§ 13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

§ 13.6.1 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may 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.

§ 13.7 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

§ 13.7.1 As between the Owner and Contractor:

.1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

.2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and

.3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped;

.2 an act of government, such as a declaration of national emergency which requires all Work to be stopped;

.3 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 payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 the Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor:

.1 persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

.3 persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 take possession of the site and 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 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 unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 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 Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in 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 the Contract.

§ 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 written 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 Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

SECTION 011000 - SUMMARY OF WORK

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 PROJECT DESCRIPTION

A. The Project consists of constructing a 7,985 SF, six classroom, addition to Seaford Elementary School and related demolition, site preparation, storm water management, utilities, a closed loop geothermal heat pump HVAC system, mechanical and plumbing systems in support thereof with a separate roof ventilating unit to provide the outside air requirement, as shown in the Contract Documents prepared by Hudson + Associates, Architects dated September 16, 2013. Work shown on the construction documents includes two additive alternates. Alternate 1 is a closed loop geothermal variable refrigerant flow AC system, mechanical and plumbing systems in support thereof with a separate roof ventilating unit to provide the outside air requirement. Alternate 2 is the enclosure of an existing 518 SF breezeway between the existing building and the detached gymnasium.

Project Name:	**Seaford Elementary School Addition** Seaford Elementary School 1105 Seaford Road Seaford, Virginia 23696
Owner:	York County School Division 302 Dare Road Yorktown, VA 23692
Architect:	Hudson + Associates, Architects PLLC 120 West Queens Way, Suite 201 Hampton, VA 23669

CONTRACTOR USE OF PREMISES

A. General: Use of premises, work and storage areas shall be discussed at the pre-construction conference. In general, areas will be made available immediately adjacent to the building for the storage of materials, and work

may be carried on between the hours of 6:30 am and 9:00 pm.

B. The building will be occupied throughout the construction and therefore special precautions must be taken to ensure staff and student safety.

E. An insulated temporary metal stud and GWB wall will be constructed across the corridor connecting to the addition to separate the work area from the remainder of the building. This wall will be removed at substantial completion.

F. Alternate 1 includes installing a closed loop geothermal variable refrigerant flow HVAC system rather than the closed loop geothermal heat pump HVAC system.

F. Should Alternate 2 be accepted construction of the breezeway enclosure will not commence until June 16, 2014 and must achieve substantial completion by August 15, 2014.

OWNER OCCUPANCY

A. Owner Occupancy: Cooperate with the Owner during construction to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations.

CONTRACT TIME

A. The Contractor shall have access to the site commencing with the Notice to Proceed. **All work must be substantially completed by August 15, 2014. Final Completion shall be no later than September 15, 2014.**

B. The Contractor should plan on the following weather (precipitation and temperature) days for the project duration, including all time extensions made to the contract, up until final completion is given. Time extensions for this project will only be given if the actual weather delay days exceed the days listed below.

January	10 Days
February	9 Days
March	11 Days
April	11 Days
May	12 Days
June	10 Days
July	11 Days
August	10 Days
September	9 Days
October	7 Days
November	8 Days
December	10 Days

A day will be considered a weather delay day when, on a work (Monday through Friday) day, it rains or snows at the job site so less than 4 hours of

production can occur or when the chance of precipitation exceeds 70% as reported by a source agreed upon at the pre-construction meeting or when the temperature does not rise above 40 degrees for more than 4 hours. Weather delay claims must be made in writing on the day they occur. Days that are weather days will be established by mutual agreement between the Owner and the Contractor on the day they occur, but the Owner will have final authority on that day to establish whether or not the day will be considered a weather delay day.

SCOPE OF WORK

A. The project includes construction of a one-story, six classroom masonry bearing wall addition. Foundations are shallow concrete with a slab on grade floor. The roof structure is steel bar joists and metal roof deck. Exterior materials include two colors of face brick, composite architectural wall panels and a cold applied two-ply modified bitumen roof system on polyisocyanurate insulation and a cover board. Exterior doors are hollow metal and windows are double thermal break storefront aluminum with insulated glazing.

B. Interior finish systems include painted block, abuse resistant GWB and CFM stud framing, acoustical panel ceilings, ceramic tile restroom floors and vinyl composition floor tiles in the corridor and classrooms. Interior door are prefinished wood in hollow metal frames.

C The base bid HVAC is a closed loop geothermal heat pump system. Outside air is provided to the classrooms from a roof mounted ventilation unit (RVU). This unit is manufactured by Engineered Air and there are no substitutions allowed.

D. Alternate 1 changes the base bid HVAC system to closed loop geothermal variable refrigerant flow HVAC system. The classroom units shall be provided as ceiling cassettes with a ducted concealed unit provided in the corridor. The VRF piping and system components indicated in the Contract Documents shall be installed in accordance with the manufacturer's recommendations. The VRF system shall be City-Multi as manufactured by Mitsubishi with no substitutions. Outside air is provided to the classrooms from a roof mounted ventilation unit (RVU). This unit is manufactured by Engineered Air and there are no substitutions allowed.

E. Gas service to the RVU will be from the existing meter located near the existing electric room and then underground to the east side of the addition and then above the addition's ceiling and through the roof to the RVU.

F. Electrical service to the addition will come from several sources including tapping an existing spare 400 amp breaker at the MDP in the existing building. This will be routed underground from the existing electric room to an existing handhold and beyond to the electric room in the addition.

G. Power and lighting requirements are shown on the construction documents. Wiring for phone, data, security, HVAC controls (excluding all City-Multi control wiring), fire alarm and security systems are handled by the Owner's Contractors. Conduit for these systems are part of the construction contract. See WORK

UNDER OTHER CONTRACT for required coordination and division of responsibilities related to these systems.

H. Sanitary sewer for the addition will replace a portion of the existing sanitary sewer on the north side of the existing school and then combine the addition's sanitary piping into the replaced sanitary lines.

I. The site development will include providing and enlarging fire access drives to the site; the addition of a fire hydrant; storm water filtering and an underground storage system; and the demolition salvage and reinstallation of an existing playground on the north side of the addition.

J. The addition is designed as a separate building from the existing school. It is separated from the existing school by three-hour fire walls including a three-hour fire rated door vault where the addition and the existing join. The main corridor is designed with one-hour fire barrier walls. The openings in these walls have fire rated doors and frames.

K. Alternate 2 encloses the existing covered breezeway between the east end of the existing school and the existing gymnasium. This work will not commence until June 16, 2014 and must be completed by August 15, 2014.

L. The Owner has conducted hazardous material testing in the building. The transite panels over the kitchen window that are to be removed are considered construction waste. If during the course of the work suspicious material is encounter, immediately notify the Mr. Frank Pitchford, YCSD's Safety Manager (e-mail fpitchford@ycsd.york.va.us or phone (757)876-8801). Mr. Pitchford will conduct testing and prepare abatement specifications and procedures as required.

WORK UNDER OTHER CONTRACT

A. Separate Contract: The Owner will have certain installations at the site completed under an existing communication services contract. Those operations will be conducted simultaneously with work under this Contract. That Contract includes the following:

1. Contract: Installation of telephone and network cabling and installation of telephones, wireless transmitters, network switches, projectors, projector screens and other data equipment.

B. Separate Contract: The Owner will have certain operations at the site completed under an existing fire and security alarm contract. Those operations will be conducted simultaneously with work under this Contract. That Contract includes the following:

1. Contract: Removal and reinstallation of existing security equipment and installation of new wiring and hardware for security and fire alarm systems

C. Separate Contract: The Owner will have certain operations at the site completed under an existing building automation controls contract. Those operations will be conducted simultaneously with work under this Contract. That Contract includes the following:

1. Contract: Removal of existing building automation controls and the installation and programming of Trend brand building automation control equipment to control and monitor pumps, exhaust fans, electric heaters, exterior lights and geothermal heat pumps (base bid). The Trend system will also monitor and control the factory installed Engineered Air Roof Top Equipment controls and the Mitsubishi City-Multi HVAC equipment controls via a Niagara AX framework and an Ethernet connection. Engineered Air will be responsible for the installation and programming of all controls in their rooftop equipment. The mechanical contractor shall be responsible for the installation and programming of all controls for the City-Multi equipment.

2. To further clarify the various roles of building automation among contractors:
   A. The mechanical contractor shall:
      1. Provide, install and program all sensors and controls required to control and monitor the Mitsubishi City-Multi HVAC system provided under Alternate 1.
      2. Assist the Owner's building automation contractor with the integration of the Mitsubishi City-Multi system and the Owner's Niagara AX framework providing mapping of point addresses between the two systems.
      3. Participate in the commissioning of the interconnectivity to ensure that all point addresses are controlling properly.
      4. Install all duct mounted sensors provided with the Engineered Air units (typically one temperature sensor and one humidity sensor per unit).
   B. The electrical contractor shall:
      Provide, install and setup the occupancy sensors that control the interior lighting.
   C. Engineered Air shall:
      1. Provide, install and program a controller for their equipment.
      2. Provide BACNET I/P interface controller to enable the factory installed controller to interface with the Owner's Niagara AX framework.
   D. The Owner's building automation contractor shall:
      1. Provide, install and program a Trend brand building automation system that shall interface with the City-Multi control system and the existing Novar building automation system in the building.
      2. Program the Owner's Niagara AX framework to interface with the City-Multi and Novar systems.
      3. Provide and install all necessary building automation system wiring (with the exception of City-Multi control wiring).

4. Provide, install and program equipment (sensors, controllers, relays, etc.) to control and monitor all exhaust fans, electric heaters, exterior lights, water heaters and circulating pumps.
5. Provide control of all Engineered Air rooftop make-up air units through the factory mounted controller(s) and interface(s).
6. Provide a graphical display for all controlled and monitored equipment including City-Multi, Engineered Air, Trend and Novar controlled equipment.
7. Connect to auxiliary contacts in the motion sensors or power packs installed for interior light control to monitor and verify proper operation.

MISCELLANEOUS PROVISIONS

A. The General Contractor shall protect the existing facilities at all times during the course of construction. Any damages caused or patching needed as a result of their activities shall be repaired at no additional cost to the Owner. In general, patching, repair, and renovation work is intended to match, compliment and align with existing conditions.

B. The General Contractor is to maintain the structural integrity of the existing building at all times. At no time is the removal or demolition of a structural element to occur without the approval of the Owner.

C. The General Contractor must have a minimum of eight (8) years' experience and must have completed three (3) school projects of a similar size and scope within the past five (5) years. Immediately after identifying the apparent low bidder that Contractor shall submit the names, addresses and phone numbers of the contact person, for each of these similar projects. These references may be used in determining the most qualified bidder irrespective of the low bid.

D. General Contractor must supply with their bid mechanical subcontractor references for at least two (2) different projects completed in the last five years by the mechanical subcontractor using the Mitsubishi City-Multi HVAC equipment OR three (3) other HVAC systems using VRF technology. Include the project names, project start and completion dates, the equipment and services provided and the name, phone number and e-mail address of the Owner's representative most closely involved in administering each of these projects.

E. General contractor must provide documentation that mechanical subcontractor personnel have attended City-Multi certification school along with their bid.

F. Contractor personnel **shall not** have access to lounges, vending machines, restrooms or telephones in the existing school building. See Section 01500 for temporary facilities requirements.

G. Smoking is **not allowed** on school property at any time, during the project.

H. Condition of the Existing Building: The General Contractor will be responsible for maintaining the building in a weather tight condition throughout the construction period and repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. Any damages caused to the Owner's property or property of any of the Owner's employees as a result of the Contractor's operations shall be repaired to the condition before the damage occurred, at the Contractor's expense.

OWNER SUPPLIED, CONTRACTOR INSTALLED EQUIPMENT

A. The Owner's supplier provides soap and toilet tissue dispensers. These items will be installed by the Contractor as shown on the Construction Drawings.

FEES AND PERMITS

A. Unless otherwise provided in the Contract Documents, the Contractor shall apply for and obtain all public permits, unless noted otherwise. Such permits include, but are not necessarily limited to, the following:

1. Building permit
2. Mechanical and electrical permits
3. Hazardous material abatement permits

B. York County will forgive the permit cost for the work they inspect.

C. The General Contractor and subcontractors shall be responsible of for modifying permits to include work added to or changed during the construction process.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 011000

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GET Solutions, Inc.

Geotechnical • Environmental • Testing

REPORT OF SUBSURFACE INVESTIGATION AND GEOTECHNICAL ENGINEERING SERVICES

Addition to Seaford Elementary School
1105 Seaford Road
Seaford, Virginia

G E T Project No: WM13-120G
May 17, 2013

Prepared for:

Hudson + Associates Architects
120 West Queens Way, Suite 201
Hampton, Virginia 23669
Attn: Mr. C. Craig Hudson, AIA

1592 Penniman Road, Suite E, Williamsburg, VA 23185
Phone 757-564-6452 ♦ Fax 757-564-6453 ♦ www.getsolutionsinc.com

GET Solutions, Inc.
Geotechnical • Environmental • Testing

May 17, 2013

TO: **Hudson + Associates Architects**
120 West Queens Way, Suite 201
Hampton, Virginia 23669

Attn: Mr. C. Craig Hudson, AIA

RE: Report of Subsurface Investigation and Geotechnical Engineering Services
Addition to Seaford Elementary School
1105 Seaford Road
Seaford, Virginia
G E T Project No: WM13-120G

Dear Mr. Hudson:

In compliance with your instructions, we have completed our Subsurface Investigation and Geotechnical Engineering Services for the referenced project. The results of this study and our recommendations for geotechnical aspects of the project are presented in this report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **G E T Solutions, Inc.** would be pleased to continue its role as Geotechnical Engineer during the project implementation.

Thank you for the opportunity to work with you on this project. We trust that the information contained herein meets your immediate needs. Should you have any questions or if we can be of further assistance, please do not hesitate to contact us.

Respectfully Submitted,
G E T Solutions, Inc.

James R. Wheeler
Project Geologist

COMMONWEALTH OF VIRGINIA
CAMILLE A. KATTAN
Lic. No. 018045
PROFESSIONAL ENGINEER

Camille A. Kattan, P.E.
Principal Engineer
VA Reg. # 018045

Copies: (1) Client via e-mail: chudson@hudsonarch.com

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EXECUTIVE SUMMARY

The project site is located at 1105 Seaford Road in Seaford, Virginia. The construction at this site is planned to consist of building an addition to the rear of the existing school. The structure will be a 1-story addition about 7,898 square feet in plan area. The addition will include CMU wall construction, brick veneer, metal roof trusses, and a concrete slab-on-grade floor. As reported by the Structural Engineer, the maximum wall loads will not exceed 2.5 klf. The finish floor elevation will be at 13.17 feet MSL. Therefore, cuts and fills required to establish finish floor elevation will be limited to about 2 feet or less.

Our field exploration program included three (3) 25-foot deep Standard Penetration Test (SPT) borings drilled within the proposed structure's footprint. A brief description of the subsurface soil conditions is tabulated below:

AVERAGE DEPTH (feet)	STRATUM	DESCRIPTION	RANGES OF SPT[(1)] N-VALUES
0 to 0.25 - 0.33	Topsoil	3 to 4 Inches of Topsoil	-
0.25 - 0.33 to 8	I	Silty and Clayey SAND (SM and SC) with trace amounts of Clay, fine Gravel, and/or organics	2 - 18
8 to 25	II	Silty, fine SAND (SM) with trace marine shell fragments [Yorktown Formation]	3 - 9

Note (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot (uncorrected)

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The groundwater table is estimated to occur at a depth of 5 feet below current grades at the boring locations. The boreholes were backfilled upon completion for safety reasons. Therefore, these results may not be indicative of the static water level.

The following evaluations and recommendations were developed based on our field exploration and laboratory-testing program:

- The proposed construction area should be cleared by means of removing all topsoil, root mat, existing concrete slabs, foundations, abandoned utilities, or any otherwise unsuitable materials. It is estimated that an initial cut of up to 4 inches in depth will be required to remove the topsoil materials.

- A field testing program is recommended during construction. This testing program should include as a subgrade load testing (proofrolling), test pits, compaction testing of subgrades and Structural Fill and foundation inspections.

- The project's budget should include an allowance for subgrade improvements (undercut of unsuitable soils and subsequent backfilling).

- Any materials proposed for use as Structural Fill should be evaluated at the time of construction (gradation, plasticity analyses, and Proctor testing).

- Shallow foundations can be designed using a net allowable bearing capacity of 1,500 psf, subject to the minimum dimensioning criteria discussed herein. Foundations may experience estimated total and differential foundation settlements up to 1-inch and ½-inch, respectively.

- The floor slab may be constructed on-grade using a modulus of subgrade reaction of 125 pci.

- On the basis of the results of our soil test borings (the upper 25 feet of the recovered soils, maximum explored depth) and our experience with similar soil conditions in the project areas, it is our opinion that this site should be classified as a Site Class "E" in accordance with Table 20.3-1 Site Classification of the ASCE 7-10 Minimum Design Loads for Buildings and Other Structures, Chapter 20 (referenced in the 2013 IBC). Typically, the seismic evaluation requires soils information associated with the upper 100 feet.

This summary briefly discusses some of the major topics mentioned in the attached report. Accordingly, this report should be read in its entirety to thoroughly evaluate the contents.

1.0 PROJECT INFORMATION

1.1 Project Authorization

G E T Solutions, Inc. has completed our Subsurface Investigation and Geotechnical Engineering Services for the Addition to Seaford Elementary School project located at 1105 Seaford Road in Seaford, Virginia. The geotechnical engineering services were conducted in general accordance with **G E T** Proposal No. PWM12-386G dated December 18, 2012. Authorization to proceed with our services was received from the client in the form of a signed agreement dated March 12, 2013.

1.2 Project Location and Site Description

The project site is located at 1105 Seaford Road in Seaford, Virginia. Specifically, the project site is located to the rear of the existing school where currently two modular structures (trailers) are located.

Currently, the area where the construction will take place contains two modular structures (trailers), associated ramps, and sidewalks along with some grass covered areas. Based on the provided plans, the site grades, surrounding the modular structures, currently range from 11.4 to 12.5 feet MSL.

1.3 Project Construction Description

The construction at this site is planned to consist of building an addition to the rear of the existing school. The structure will be a 1-story addition about 7,898 square feet in plan area. The addition will include CMU wall construction, brick veneer, metal roof trusses, and a concrete slab-on-grade floor. As reported by the Structural Engineer, the maximum wall loads will not exceed 2.5 klf. The finish floor elevation will be at 13.17 feet MSL. Therefore, cuts and fills required to establish finish floor elevation will be limited to about 2 feet or less.

If any of the noted information is incorrect or has changed, please inform **G E T Solutions, Inc.** so that we may amend the recommendations presented in this report, if appropriate.

1.4 Purpose and Scope of Services

The purpose of this study was to obtain information on the general subsurface conditions at the project site. The subsurface conditions encountered were evaluated with respect to the available project characteristics. In this regard, engineering assessments for the following items were formulated:

1. General assessment of the soils revealed by the borings performed at the project site.

2. General location and description of potentially deleterious material encountered in the borings that may interfere with construction progress or structure performance, including existing fills or surficial/subsurface organics.

3. Evaluation of earthwork requirements, to include subgrade stripping and preparation, Structural Fill suitability, and fill placement procedures. Evaluation of the suitability of on-site soils for re-use as Structural Fill.

4. Shrink/Swell characteristics of the shallow subsurface soils.

5. Feasibility of utilizing a shallow foundation system for support of the proposed structure. Design parameters required for the foundation systems, including foundation sizes, allowable bearing pressures, foundation levels, and expected total and differential settlements, as well as shrink/swell related design and construction recommendations.

6. Evaluation of a slab-on-grade floor system, to include subgrade modulus.

7. Seismic Site Class definition in accordance with the International Building Code (IBC) 2012 requirements, available soil data, and our local experience.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic material in the soil, bedrock, surface water, groundwater or air, on or below or around this site. Prior to development of this site, an environmental assessment is advisable.

2.0 FIELD AND LABORATORY PROCEDURES

2.1 Field Exploration

In order to explore the general subsurface soil types and to aid in developing associated foundation design parameters, three (3) 25-foot deep Standard Penetration Test (SPT) borings (designated as B-1, B-2, and B-3) were drilled by **G E T Solutions, Inc.** within the proposed structure's footprint.

The SPT borings were performed with the use of rotary wash "mud" drilling procedures in general accordance with ASTM D 1586. The tests were performed continuously from the existing ground surface to a depth of 12 feet, and at 5-foot intervals thereafter. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches, using an automatic hammer. The number of blows required to drive the sampler each 6-inch increment of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value (uncorrected for automatic hammer). A representative portion of each disturbed split-spoon sample was collected with each SPT, placed in a glass jar, sealed, labeled, and returned to our laboratory for review.

The boring locations were established and located in the field by a representative of **G E T Solutions, Inc.** The approximate boring locations are shown on the attached Boring Location Plan (Appendix I), which was reproduced from a civil drawing (dated March 1, 2013) provided by the client.

2.2 Laboratory Testing

Representative portions of all soil samples collected during drilling were sealed in glass jars, labeled, and transferred to our laboratory for classification and analysis. The soil classification was performed by a Geologist in accordance with ASTM D2488. The classification system for soil exploration is included in Appendix II.

Four (4) representative soil samples were selected and subjected to natural moisture and -#200 sieve wash testing and analysis in order to corroborate the visual classification. These test results are tabulated below and are also presented on the "Boring Log" sheet in Appendix III.

Table I – Laboratory Test Results

Boring No.	Depth (Feet)	Natural Moisture (%)	Percent Passing #200	USCS Classification
B-1	4-6	36	27	SC
B-2	6-8	37	28	SM
B-3	2-4	12	32	SM
B-3	6-8	37	31	SM

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The project site is located in York County, Virginia which lies within a major physiographic province called the Atlantic Coastal Plain. Numerous transgressions and regressions of the Atlantic Ocean have deposited marine, lagoonal, and fluvial (stream lain) sediments generally in bands paralleling the coast. The regional geology is very complex, and generally consists of interbedded layers of varying mixtures of sands, silts and clays. Near surface materials are Clay and Sand fluvial and alluvial sediments which were generally deposited within the last 20,000 years. Ancient stream channels now buried and containing soft marine sediments are present throughout the area.

3.2 Subsurface Soil Conditions

The results of our field exploration program are indicated in a tabular form below:

Table II – Subsurface Soil Conditions

AVERAGE DEPTH (feet)	STRATUM	DESCRIPTION	RANGES OF SPT(1) N-VALUES
0 to 0.25 - 0.33	Topsoil	3 to 4 Inches of Topsoil	-
0.25 - 0.33 to 8	I	Silty and Clayey SAND (SM and SC) with trace amounts of Clay, fine Gravel, and/or organics	2 - 18
8 to 25	II	Silty, fine SAND (SM) with trace marine shell fragments [Yorktown Formation]	3 - 9

Note (1) SPT = Standard Penetration Test, N-Values in Blows-per-foot (uncorrected)

The topsoil designation references the presence of surfical organic laden soil, and does not represent any particular quality specification. This material should be tested for approval prior to its use.

The subsurface description is of a generalized nature provided to highlight the major soil strata encountered. The records of the subsurface exploration are included in Appendix III (Boring Logs) and in Appendix IV (Generalized Soil Profile), which should be reviewed for specific information as to the individual borings. The stratifications shown on the records of the subsurface exploration represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual or occur between sample intervals. In addition, the elevations as provided on the boring logs are estimated based on the provided plans.

3.3 Shrink/Swell Characteristics

The soils recovered during our field exploration were tested and evaluated for their potential to expand or contract with moisture changes (typically termed shrink-swell). Shallow foundations constructed on expansive soils at certain depths may be subjected to detrimental uplift or horizontal forces caused by the swelling of these soils as a result of an increase in the moisture content. Conversely, as these Clays loose moisture they may shrink, adversely affecting the foundations. The depth to which soils are normally affected by moisture changes extends to about 3 to 6 feet below existing grades in this area, depending on site topography and drainage characteristics.

The soils within the project limits are mapped by the USDA Soil Survey of York County as Urban Land soils. Urban Land is not mapped by the USDA Soil Survey, but typically indicates FILL materials are present on the project site. However, FILL materials were not observed at our boring locations, but may be present elsewhere within the project limits. Based on our field and laboratory investigation, the natural soils at this project site to a depth of 6 feet are considered to have predominately a low expansive (shrink-swell) potential.

3.4 Groundwater Information

The groundwater level was recorded at the boring locations and as observed through the relative wetness of the recovered soil samples during the drilling operations. The groundwater table is estimated to occur at a depth of 5 feet below current grades at the boring locations. The boreholes were backfilled upon completion for safety reasons. Therefore, these results may not be indicative of the static water level.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales, drainage ponds, underdrains, and areas of covered soil (paved parking lots, side walks, etc.). In the project area, seasonal groundwater fluctuations of $\pm$ 3 feet are common; however, greater fluctuations have been documented. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine groundwater impact on the construction procedures, if necessary.

4.0 EVALUATION AND RECOMMENDATIONS

Our recommendations are based on the previously discussed project information, our interpretation of the SPT borings and laboratory data, and our observations during our site reconnaissance. If the proposed construction should vary from what has been described herein, or should differing conditions be encountered during construction, we request the opportunity to review our recommendations and make any necessary changes.

4.1 Clearing and Grading

The proposed building construction area should be cleared by means of removing all topsoil, root mat, unsuitable FILL, existing concrete slabs, foundations, abandoned utilities, or any otherwise unsuitable materials. It is estimated that an initial cut of up to 4 inches in depth will be required to remove the topsoil materials. This cut is expected to extend deeper in isolated areas to remove deeper deposits of unsuitable soils, organics, unsuitable FILL, existing concrete slabs, foundations, and/or abandoned utilities which become evident during the clearing. It is recommended that the clearing operations extend laterally at least 5 feet beyond the perimeter of the proposed construction areas.

The results of our field exploration program indicated that the soils below the topsoil consisted of Silty and Clayey SAND (SM and SC), which contained appreciable amounts of fines. Combinations of excess surface moisture from precipitation ponding on the site and the construction traffic, including heavy compaction equipment, may create pumping and general deterioration of the bearing capabilities of the surface soils. Soils with moisture contents above their optimum moisture contents tend to soften during the stripping and grading activities. Therefore, undercutting to remove very soft soils in isolated areas should be anticipated. In this regard, and in order to reduce the potential for undercutting, care should be exercised during the grading and construction operations at the site. Furthermore, inherently wet subgrade soils combined with potential poor site drainage make this site particularly susceptible to subgrade deterioration. Thus, grading should be performed during a dry season if at all possible. This should minimize these potential problems, although they may not be eliminated.

It is recommended that the budget include an allowance for undercutting of unsuitable soils and replacing them with Imported Structural Fill. Control of surface water is very important to the successful completion of the proposed construction. The contractor should plan his grading activities to control surface water and minimize erosion of exposed cut or fill material. This may include constructing temporary berms, ditches, and swales to intercept runoff and discharge it in a controlled fashion.

4.2 Subgrade Preparation

Following the clearing operation, the exposed subgrade soils should be densified with a large static drum or sheepsfoot roller. Subgrades to a depth of at least 6 inches should be compacted to a dry density of at least 95% of the Standard Proctor maximum dry density, in accordance with ASTM D 698 (if possible). The moisture content of the subgrade should be within +/- 2% of the optimum moisture content at the time of compaction. These compaction and moisture recommendations may not be achievable in a relatively wet environment. As such, some subgrade improvements should be expected.

After the subgrade soils have been compacted, they should be evaluated by **G E T Solutions, Inc.** for stability. Accordingly, the subgrade soils should be proofrolled to check for pockets of loose material hidden beneath a crust of better soil. Several passes should be made by a large rubber-tired roller or loaded dump truck over the construction areas, with the successive passes aligned perpendicularly (if possible). The number of passes will be determined in the field by the Geotechnical Engineer depending on the soil conditions. Any pumping and unstable areas observed during proofrolling (beyond the initial cut) should be undercut and/or stabilized at the direction of the Geotechnical Engineer. These improvement recommendations (where required) should also consider the thickness of the building pad fill and its ability to bridge marginal areas.

Recommendations concerning the subgrade improvements (as necessary) will be provided in the field following the testing procedures. Again, the project's budget should include an allowance for subgrade improvements (undercut/backfill with Structural Fill).

4.3 Structural Fill and Placement

Any material to be used for Structural Fill should be evaluated and tested by **G E T Solutions, Inc.** prior to placement to determine if they are suitable for the intended use. Suitable Structural Fill material should consist of sand or gravel containing less than 25% by weight of fines (SP, SM, SW, GP, GW - with dimensions not to exceed 2 inches in diameter), having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris and other unsuitable material.

All Structural Fill should be compacted to a dry density of at least 95% of the Standard Proctor maximum dry density, in accordance with ASTM D 698. The moisture content of the structural fill should be within +/- 2% of the optimum moisture content at the time of placement. In general, the compaction should be accomplished by placing the fill in maximum 8-inch loose lifts and mechanically compacting each lift to at least the specified minimum dry density.

We recommend that fill placement be monitored on a full-time basis by a qualified Geotechnical Engineering firm to verify that the specified materials are used and the required degree of compaction is achieved.

Surface water control measures should be instituted to protect the new fill from erosion. A protective cover of grass or other vegetation should be established on permanent slopes as soon as possible during construction. New fill should be benched into existing slopes, where applicable.

It does not appear that dewatering will be required for mass grading, except where localized surface moisture might be present. Utility excavations could encounter the groundwater table, depending on utility depth and location on site. Dewatering at depths below the groundwater will likely require well pointing. Seepage from shallow perched water may require pumping from sumps, depending on seasonal conditions. Prior to bidding and/or construction, the grading contractor should determine actual groundwater conditions at the location of deep excavations so its impact on the project can be determined.

4.4 Suitability of On-Site Soils

Some of the shallow Silty SAND (SM) soils of Stratum I may be suitable for reuse as Structural Fill. However, soils encountered near or below the groundwater table will require significant moisture manipulation prior to their reuse. Further classification testing (natural moisture content, gradation analysis, and Proctor testing) should be performed in the field during construction to evaluate the suitability of excavated soils for reuse as fill within building area.

4.5 Foundation Design Recommendations

Provided that the construction procedures are properly performed, the proposed structure can be supported by shallow foundations bearing upon firm natural soil or well compacted Structural Fill placed over firm, natural subgrades. The footings can be designed using a net allowable soil pressure of 1,500 pounds per square foot (psf) bearing on firm natural soil or well compacted structural fill. In using net pressures, the weight of the footings and balanced backfill over the footings, including the weight of the floor slab, need not be considered. Hence, only loads applied at or above the finished floor need to be used for dimensioning the footings.

In order to develop the recommended bearing capacity of 1,500 psf, the base of the footings should have an embedment of at least 18 inches beneath finished grades. Continuous footings should have a minimum width of 24 inches. The recommended 18-inch footing embedment is considered sufficient to provide adequate cover against frost penetration to the bearing soils.

4.6 Settlements

It is estimated that, with proper site preparation, the maximum resulting total settlement of the proposed structure's foundations should be up to 1 inch. The maximum differential settlement magnitude is expected to be less than ½-inch between adjacent footings. The settlements were estimated on the basis of the results of the field penetration tests and soil consolidation testing. Careful field control will contribute substantially towards minimizing the settlements.

Some of the new foundations associated with the proposed structure will be located adjacent to those of the existing structures. As such, the underlying soils at these locations will be subjected to a stress increase as a result of the new foundation structural loads and fill loads. This stress increase is anticipated to result in an additional ¼ to ½-inch of settlement at the new and old foundation interfaces. This additional settlement may result in some minor cracking of any existing masonry or a widening or lengthening of any existing cracks. It is recommended that the new foundations and structure for the proposed addition be structurally independent from the existing foundations and structure.

4.7 Foundation Excavations

In preparation for shallow foundation support, the footing excavations should extend into firm natural soil or well compacted Structural Fill. The foundation bearing capacities should be verified in the field during construction by means of performing an inspection of all footings. At that time, the Geotechnical Engineer will explore the extent of excessively loose, soft, or otherwise unsuitable material within the exposed excavations. Also, at the time of the footing observations, the Geotechnical Engineer should perform hand auger borings or use a hand penetration device in the bases of the foundation excavations. The necessary depth of penetration will be established during the subgrade observations.

Where foundation undercut is performed, the design footing elevation should be re-established by backfilling with flowable fill or compacted lifts of VDOT No. 57 Stone. Immediately prior to foundation concrete placement, it is suggested that the bearing surfaces of all foundations be compacted using hand operated mechanical tampers. In this manner, any localized areas, which have been loosened by excavation operations, should be adequately recompacted. The compaction testing in the base of the foundation may be waived by the Geotechnical Engineer where firm bearing soils are observed during the foundation inspections.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition such as from physical disturbance, rain or frost. Surface run-off water should be drained away from the foundation excavations and slab areas and not be allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not possible, the footing excavations should be adequately protected.

4.8 Slab-on-Grade Design

The floor slab may be constructed as a slab-on-grade member provided the previously recommended earthwork activities and evaluations are properly accomplished. It is recommended that all ground floor slabs be "floating". That is, generally ground supported and not rigidly connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation. Alternately, an at grade slab with turn down edges may be employed.

It is recommended that all ground floor slabs be directly supported by a Porous Fill layer. The Porous Fill can consist of at least 6 inches of relatively clean, compacted, poorly graded Sand (SP) or gravel (GP) with less than 5% passing the No. 200 Sieve (0.074 mm). ASTM C33 Concrete Sand and VDOT Size No. 57 Stone are considered suitable for this purpose. The purposes of the Porous Fill layer are to serve as a capillary barrier, equalizing moisture conditions beneath the slab, and to provide for more uniform slab support.

It is recommended that a vapor barrier be employed over the Porous Fill in heated areas to minimize the potential for floor dampness, which can affect the performance of glued tile, carpet, and finishes.

Floor slabs-on-grade constructed as discussed herein can be designed assuming a subgrade modulus of 125 pci.

4.9 Seismic Site Class

On the basis of the results of our soil test borings (the upper 25 feet of the recovered soils, maximum explored depth) and our experience with similar soil conditions in the project areas, it is our opinion that this site should be classified as a Site Class "E" in accordance with Table 20.3-1 Site Classification of the ASCE 7-10 Minimum Design Loads for Buildings and Other Structures, Chapter 20 (referenced in the 2013 IBC). Typically, the seismic evaluation requires soils information associated with the upper 100 feet. If the site classification is critical to the structural design it will be necessary to perform a 100-foot deep CPT boring (or to refusal) with shear wave velocity testing to substantiate the site classification.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Drainage and Groundwater Concerns

It is expected that dewatering may be required for excavations that extend near or below the groundwater table. Dewatering above the groundwater level could probably be accomplished by pumping from sumps. Dewatering at depths below the groundwater level will require well pointing. In addition, it is recommended to tie roof drains to the storm water system and situate downspouts in such a manner to prevent ponding water near the foundations.

It would be advantageous to construct all fills early in the construction. If this is not accomplished, disturbance of the existing site drainage could result in collection of surface water in some areas, thus rendering these areas wet and very loose. Temporary drainage ditches should be employed by the contractor to accentuate drainage during construction. We recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on this project.

5.2 Site Utility Installation

The base of the utility trenches should be observed by a qualified inspector prior to the pipe and structure placements to verify the suitability of the bearing soils. Based on the results of our field exploration program it is expected that the utilities and structures may bear in very loose to loose granular soils. If unstable bearing soils are encountered during installation some form of stabilization may be required to provide suitable bedding. This stabilization is typically accomplished by providing additional bedding materials (VDOT #57 stone). In addition, depending on the depth of the utility trench excavation, some means of dewatering may be required to facilitate the utility installation and associated backfilling. All utility excavations should be backfilled with structural fill, as described in Section 4.3 of this report. Some of the Silty SAND (SM) soils of Stratum I may be suitable for reuse as utility backfill. However, significant moisture manipulation will be required for those soils encountered near or below the groundwater table. As such, imported structural fill may be necessary to expedite utility installation.

5.3 Excavations

In Federal Register, Volume 54, No. 209 (October, 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new (OSHA) guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. **G E T Solutions, Inc.** is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.0 REPORT LIMITATIONS

The recommendations submitted are based on the available soil information obtained by **G E T Solutions, Inc.** and the information supplied by the client and its consultants for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, **G E T Solutions, Inc.** should be notified immediately to determine if changes in the foundation recommendations are required. If **G E T Solutions, Inc.** is not retained to perform these functions, **G E T Solutions, Inc.** can not be responsible for the impact of those conditions on the geotechnical recommendations for the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete the Geotechnical Engineer should be provided the opportunity to review the final design plans and specifications to assure our engineering recommendations have been properly incorporated into the design documents so that the earthwork and foundation recommendations can be properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of **Hudson + Associates Architects** and their consultants for the specific application to the Addition to Seaford Elementary School project located in Seaford, Virginia.

APPENDICES

I. BORING LOCATION PLAN

II. CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

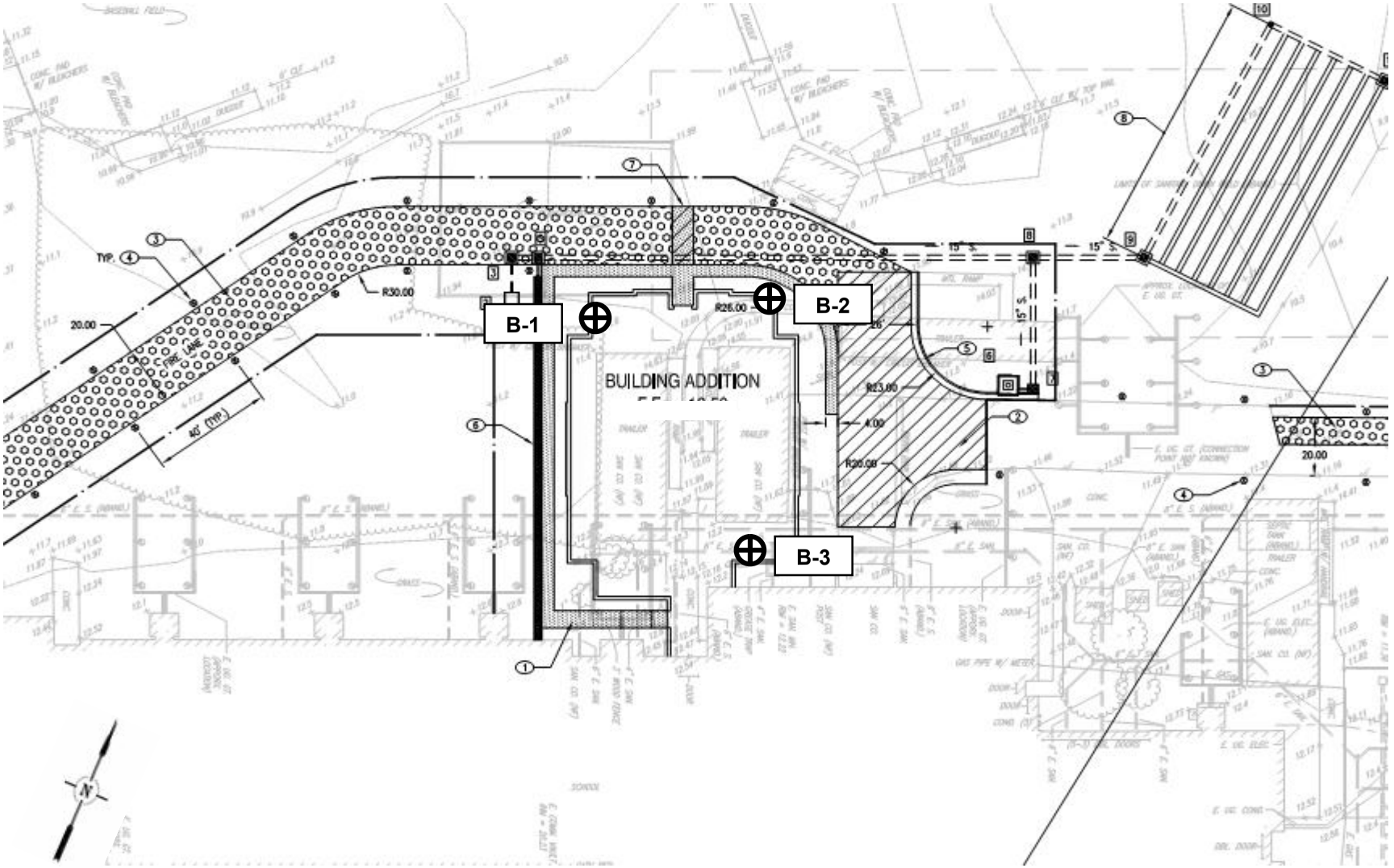
III. BORING LOGS

IV. GENERALIZED SOIL PROFILE

APPENDIX I

BORING LOCATION PLAN

Locations are approximate based on site visit sketch.



Boring Location Plan

Project: Addition to Seaford Elementary School
1105 Seaford Road
Seaford, Virginia
Project No: WM13-120G
Client: Hudson + Associates, Architects

Scale: As Drawn
Date: 5/17/2013
Plot By: JW

APPENDIX II

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

GET Solutions, Inc.
Geotechnical • Environmental • Testing

Virginia Beach Office
204 Grayson Road
Virginia Beach, VA 23462
(757) 518-1703

Williamsburg Office
1592 Penniman Rd. Suite E
Williamsburg, Virginia 23185
(757) 564-6452

Elizabeth City Office
504 East Elizabeth St. Suite 2
Elizabeth City, NC 27909
(252) 335-9765

CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

Standard Penetration Test (SPT), N-value

Standard Penetration Tests (SPT) were performed in the field in general accordance with ASTM D 1586. The soil samples were obtained with a standard 1.4" I.D., 2" O.D., 30" long split-spoon sampler. The sampler was driven with blows of a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment (4 increments for each soil sample) of penetration was recorded and is shown on the boring logs. The sum of the second and third penetration increments is termed the SPT N-value.

NON COHESIVE SOILS

(SILT, SAND, GRAVEL and Combinations)

Relative Density

Very Loose	4 blows/ft. or less
Loose	5 to 10 blows/ft.
Medium Dense	11 to 30 blows/ft.
Dense	31 to 50 blows/ft.
Very Dense	51 blows/ft. or more

COHESIVE SOILS

(CLAY, SILT and Combinations)

Consistency

Very Soft	2 blows/ft. or less
Soft	3 to 4 blows/ft.
Medium Stiff	5 to 8 blows/ft.
Stiff	9 to 15 blows/ft.
Very Stiff	16 to 30 blows/ft.
Hard	31 blows/ft. or more

Particle Size Identification

Boulders		8 inch diameter or more
Cobbles		3 to 8 inch diameter
Gravel	Coarse	1 to 3 inch diameter
	Medium	$^1/_2$ to 1 inch diameter
	Fine	$^1/_4$ to $^1/_2$ inch diameter
Sand	Coarse	2.00 mm to $^1/_4$ inch (diameter of pencil lead)
	Medium	0.42 to 2.00 mm (diameter of broom straw)
	Fine	0.074 to 0.42 mm (diameter of human hair)
Silt		0.002 to 0.074 mm (cannot see particles)

Relative Proportions

Descriptive Term	Percent
Trace	0-5
Few	5-10
Little	15-25
Some	30-45
Mostly	50-100

Strata Changes

In the column "Description" on the boring log, the horizontal lines represent approximate strata changes.

Groundwater Readings

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as tidal influences and man-made influences, such as existing swales, drainage ponds, underdrains and areas of covered soil (paved parking lots, side walks, etc.).

CLASSIFICATION SYMBOLS (ASTM D 2487 and D 2488)

Coarse Grained Soils

More than 50% retained on No. 200 sieve

GW - Well-graded Gravel
GP - Poorly graded Gravel
GW-GM - Well-graded Gravel w/Silt
GW-GC - Well-graded Gravel w/Clay
GP-GM - Poorly graded Gravel w/Silt
GP-GC - Poorly graded Gravel w/Clay
GM - Silty Gravel
GC - Clayey Gravel
GC-GM - Silty, Clayey Gravel
SW - Well-graded Sand
SP - Poorly graded Sand
SW-SM - Well-graded Sand w/Silt
SW-SC - Well-graded Sand w/Clay
SP-SM - Poorly graded Sand w/Silt
SP-SC - Poorly graded Sand w/Clay
SM - Silty Sand
SC - Clayey Sand
SC-SM - Silty, Clayey Sand

Fine-Grained Soils

50% or more passes the No. 200 sieve

CL - Lean Clay
CL-ML - Silty Clay
ML - Silt
OL - Organic Clay/Silt
Liquid Limit 50% or greater
CH - Fat Clay
MH - Elastic Silt
OH - Organic Clay/Silt

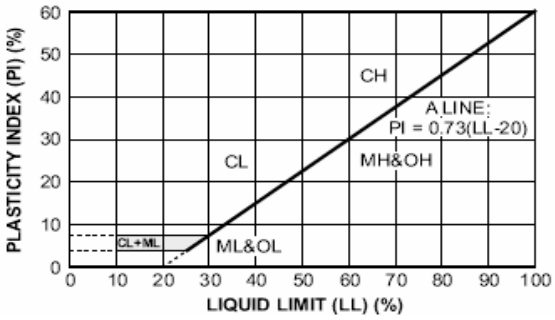
Highly Organic Soils

PT - Peat

Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent	GW, GP, SW,SP
More than 12 percent	GM, GC, SM, SC
5 to 12 percent	Borderline cases requiring dual symbols

Plasticity Chart



APPENDIX III

BORING LOGS

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-1

PROJECT: Addition to Seaford Elementary School
CLIENT: Hudson + Associates, Architects
PROJECT LOCATION: Seaford, Virginia
PROJECT NO.: WM13-120G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION: 11.6'
DRILLER: GET Solutions, Inc
LOGGED BY: KT
DRILLING METHOD: Rotary Wash "Mud"
DATE: 4/5/2013
DEPTH TO WATER - INITIAL*: ▽ 5' **AFTER 24 HOURS:** ▽ NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N Value	% < #200
	0	0								
			4 inches of topsoil							
10			0.33 Dark gray, moist, Silty, fine to medium SAND (SM) with trace fine Gravel, Loose		1	18	SS	2 4 3 3	7	
			2 Brown, moist, Silty, fine to medium SAND (SM), Medium Dense		2	24	SS	4 9 8 8	17	
		5	4 Gray and orange-brown, moist to wet, Clayey, fine SAND (SC), Loose		3	24	SS	7 4 2 2	6	27
5	2		Wet Below 5 Feet							
			6 Brown, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, Very Loose		4	24	SS	2 1 2 2	3	
			8 Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, Very Loose to Loose [Yorktown Formation]		5	24	SS	1 1 3 2	4	
		10								
0					6	24	SS	1 2 2 3	4	
	4									
		15			7	24	SS	2 2 2 3	4	
-5										
					8	24	SS	2 2 2 3	4	
	6	20								
-10										
					9	24	SS	2 3 3 3	5	
		25								
-15	8		Boring terminated at 25 ft.							
		30								
-20										
	10									
		35								
-25										

TEST RESULTS
Plastic Limit ⊢ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes: The boring elevation was derived from elevations obtained from the provided civil drawings and have not been field verified by a licensed surveyor.

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-2

PROJECT: Addition to Seaford Elementary School
CLIENT: Hudson + Associates, Architects
PROJECT LOCATION: Seaford, Virginia
PROJECT NO.: WM13-120G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION: 11.9'
DRILLER: GET Solutions, Inc
LOGGED BY: KT
DRILLING METHOD: Rotary Wash "Mud"
DATE: 4/5/2013
DEPTH TO WATER - INITIAL*: ▽ 5' **AFTER 24 HOURS:** ▽ NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N Value	% < #200
	0	0								
			4 inches of topsoil (0.33)							
10			Dark gray, moist, Silty, fine to medium SAND (SM), Medium Dense		1	18	SS	1 5 8 9	13	
		2	Gray, moist, Silty, fine to medium SAND (SM) with trace Clay, Medium Dense		2	24	SS	9 10 8 7	18	
		4								
		5 ▽	Gray and orange-brown, moist to wet, Clayey, fine SAND (SC), Loose Wet Below 5 Feet		3	24	SS	6 5 2 2	7	
5	2	6	Brown, wet, Silty, fine SAND (SM) with trace marine shell fragments, Very Loose		4	24	SS	2 1 2 2	3	28
		8	Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, Very Loose to Loose [Yorktown Formation]		5	24	SS	1 2 2 3	4	
		10								
0					6	24	SS	1 2 3 4	5	
	4									
		15			7	24	SS	2 2 3 3	5	
-5										
	6	20			8	24	SS	2 2 2 4	4	
-10										
		25			9	24	SS	2 3 3 3	5	
	8		Boring terminated at 25 ft.							
-15										
		30								
-20	10									
		35								
-25										

TEST RESULTS
Plastic Limit ⊢ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes: The boring elevation was derived from elevations obtained from the provided civil drawings and have not been field verified by a licensed surveyor.

*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

GET Solutions, Inc.
Geotechnical • Environmental • Testing

BORING LOG B-3

PROJECT: Addition to Seaford Elementary School
CLIENT: Hudson + Associates, Architects
PROJECT LOCATION: Seaford, Virginia
PROJECT NO.: WM13-120G
BORING LOCATION: See Attached Boring Location Plan
SURFACE ELEVATION: 12.5'
DRILLER: GET Solutions, Inc
LOGGED BY: KT
DRILLING METHOD: Rotary Wash "Mud"
DATE: 4/5/2013
DEPTH TO WATER - INITIAL*: ▽ 5' **AFTER 24 HOURS:** ▽ NT **CAVING>** C

Elevation (MSL) (ft)	Depth (meters)	Depth (feet)	Description	Graphic	Sample No.	Sample Recovery	Sample Type	Blows Per 6"	N Value	% < #200
	0	0								
			3 inches of topsoil		1	12	SS	3 3 4 4	7	
			0.25 Dark gray, moist, Silty, fine to medium SAND (SM) with trace organics, Loose							
10			2 Gray, moist to wet, Silty, fine SAND (SM) with trace Clay, Loose Wet Below 5 Feet		2	24	SS	3 3 4 8	7	32
		5 ▽			3	24	SS	5 6 3 2	9	31
	2		6 Gray and orange-brown, wet, Silty, fine SAND (SM) with trace Clay and marine shell fragments, Very Loose		4	24	SS	2 1 1 2	2	
5			8 Gray, wet, Silty, fine SAND (SM) with trace marine shell fragments, Loose to Very Loose [Yorktown Formation]		5	24	SS	2 4 5 7	9	
		10			6	24	SS	3 3 4 3	7	
0	4									
					7	24	SS	2 2 3 4	5	
		15								
-5										
	6				8	24	SS	2 2 2 3	3	
		20								
-10										
					9	24	SS	2 3 3 4	6	
		25								
	8		Boring terminated at 25 ft.							
-15										
		30								
-20	10									
		35								

TEST RESULTS
Plastic Limit ⊢ Liquid Limit
Moisture Content - ●
N-Value - ▨
10 20 30 40 50 60 70

Notes: The boring elevation was derived from elevations obtained from the provided civil drawings and have not been field verified by a licensed surveyor.

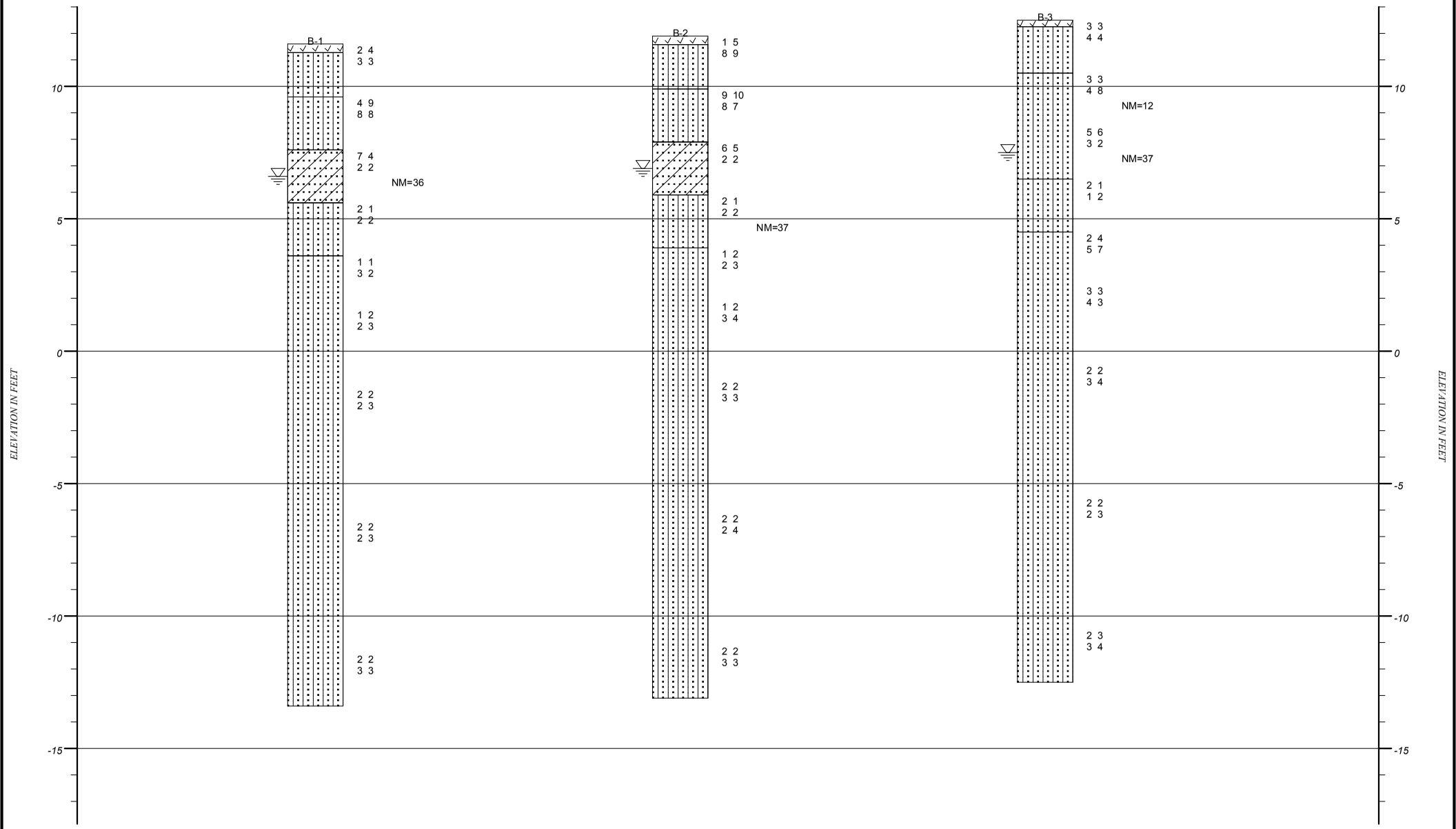
*The initial groundwater reading may not be indicative of the static groundwater level.

SS = Split Spoon Sample
ST = Shelby Tube Sample
HA = Hand Auger Sample
BS = Bulk Sample
WOH = Weight of Hammer

Standard Penetration Tests were performed in the field in general accordance with ASTM D 1586.

APPENDIX IV

GENERALIZED SOIL PROFILE



Strata symbols

- Topsoil
- Silty Sand
- Clayey Sand

GET Solutions, Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=5'	KT	5/16/2013

Addition to Seaford Elementary School
Seaford, Virginia

PROJECT NO. WM13-120G

FIGURE NUMBER 1

Formation Thermal Conductivity
Test & Data Analysis

Test Location **Seaford Elementary School**
Seaford, VA

Test Date June 12-14, 2013

Analysis For Toano Well and Pump Service, Inc.
P.O. Box 306
Toano, VA 23168
Phone: 757-566-0377
Fax: 757-566-9073

Test Performed By Toano Well and Pump Service, Inc.

EXECUTIVE SUMMARY

A formation thermal conductivity test was performed at the Seaford Elementary School site at 1105 Seaford Road in Seaford, Virginia. The vertical bore was completed on June 2, 2013 by Toano Well and Pump Service, Inc. Geothermal Resource Technologies' (GRTI) test unit was attached to the vertical bore on the morning of June 12, 2013.

This report provides an overview of the test procedures and analysis process, along with plots of the loop temperature and input heat rate data. The collected data was analyzed using the "line source" method and the following average formation thermal conductivity was determined.

Formation Thermal Conductivity = 1.12 Btu/hr-ft-°F

Due to the necessity of a thermal diffusivity value in the design calculation process, an estimate of the average thermal diffusivity was made for the encountered formation.

Formation Thermal Diffusivity ≈ 0.83 ft^2/day

The undisturbed formation temperature for the tested bore was established from the initial loop temperature data collected at startup.

Undisturbed Formation Temperature ≈ 60.8-61.8°F

The formation thermal properties determined by this test do not directly translate into a loop length requirement (i.e. feet of bore per ton). These parameters, along with many others, are inputs to commercially available loop-field design software to determine the required loop length. Additional questions concerning the use of these results are discussed in the frequently asked question (FAQ) section at www.grti.com.

TEST PROCEDURES

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has published recommended procedures for performing formation thermal conductivity tests in the ASHRAE HVAC Applications Handbook, Geothermal Energy Chapter. The International Ground Source Heat Pump Association (IGSHPA) also lists test procedures in their Design and Installation Standards. GRTI's test procedures meet or exceed those recommended by ASHRAE and IGSHPA, with the specific procedures described below:

Grouting Procedure for Test Loops – To ensure against bridging and voids, it is recommended that the bore annulus is uniformly grouted from the bottom to the top via tremie pipe.

Time Between Loop Installation and Testing – A minimum delay of five days between loop installation and test startup is recommended for bores that are air drilled, and a minimum waiting period of two days for mud rotary drilling.

Undisturbed Formation Temperature Measurement – The undisturbed formation temperature should be determined by recording the loop temperature as the water returns from the u-bend at test startup.

Required Test Duration – A minimum test duration of 36 hours is recommended, with a preference toward 48 hours**.**

Data Acquisition Frequency - Test data is recorded at five minute intervals.

Equipment Calibration/Accuracy – Transducers and datalogger are calibrated per manufacturer recommendations. Manufacturer stated accuracy of power transducers is less than ±2%. Temperature sensor accuracy is periodically checked via ice water bath.

Power Quality – The standard deviation of the power should be less than or equal to 1.5% of the average power, with maximum power variation of less than or equal to 10% of the average power.

Input Heat Rate – The heat flux rate should be 51 Btu/hr (15 W) to 85 Btu/hr (25 W) per foot of installed bore depth to best simulate the expected peak loads on the u-bend.

Insulation – GRTI's equipment has 1 inch of foam insulation on the FTC unit and 1/2 inch of insulation on the hose kit connection. An additional 2 inches of insulation is provided for both the FTC unit and loop connections by insulating blankets.

Retesting in the Event of Failure – In the event that a test fails prematurely, a retest may not be performed until the bore temperature is within 0.5°F of the original undisturbed formation temperature or until a period of 14 days has elapsed.

DATA ANALYSIS

Geothermal Resource Technologies, Inc. (GRTI) uses the "line source" method of data analysis to determine the thermal conductivity of the formation. The line source method assumes an infinitely thin line source of heat in a continuous medium. A plot of the late-time temperature rise of the line source temperature versus the natural log of elapsed time will follow a linear trend. The linear slope is inversely proportional to the thermal conductivity of the medium. If a u-bend grouted in a borehole is used to inject heat into the ground at a constant rate in order to determine the average formation thermal conductivity, the test must be run long enough to allow the finite dimensions of the u-bend pipes and the grout to become insignificant. Experience has shown that approximately ten hours is required to allow the error of early test times and the effects of finite borehole dimensions to become insignificant.

In order to analyze real data from a formation thermal conductivity test, the average temperature of the water entering and exiting the u-bend heat exchanger is plotted versus the natural log of elapsed testing time. Using the Method of Least Squares, linear equation coefficients to produce a line that fits the data are calculated. This procedure is normally repeated for various time intervals to ensure that variations in the power or other effects are not producing inaccurate results.

The calculated results are based on test bore information submitted by the driller/testing agency. GRTI is not responsible for inaccuracies in the results due to erroneous bore information. All data analysis is performed by personnel that have an engineering degree from an accredited university with a background in heat transfer and experience with line source theory. The test results apply specifically to the tested bore. Additional bores at the site may have significantly different results depending upon variations in geology and hydrology.

Through the analysis process, the collected raw data is converted to spreadsheet format (Microsoft Excel®) for final analysis. If desired, please contact GRTI and a copy of the data will be made available in either a hard copy or electronic format.

CONTACT: Galen Streich
Regional Managing Engineer
Elkton, SD
(605) 692-9069
gstreich@grti.com

TEST BORE DETAILS

(AS PROVIDED BY TOANO WELL AND PUMP SERVICE, INC.)

Site Name	Seaford Elementary School
Location	Seaford, VA
Driller	Toano Well and Pump Service, Inc.
Installed Date	June 2, 2013
Borehole Diameter	5 1/4 inches
U-Bend Size	1 inch HDPE
U-Bend Depth Below Grade	300 ft
Grout Type	Wyo-Ben Therm-Ex
Grout Solids	200 lb sand per 50 lb bentonite
Grouted Portion	Entire bore

DRILL LOG

FORMATION DESCRIPTION	DEPTH (FT)
Orange clay	0'-10'
Brown sand	10'-40'
Gray sand and shell	40'-210'
Brown and gray clay	210'-320'

THERMAL CONDUCTIVITY TEST DATA

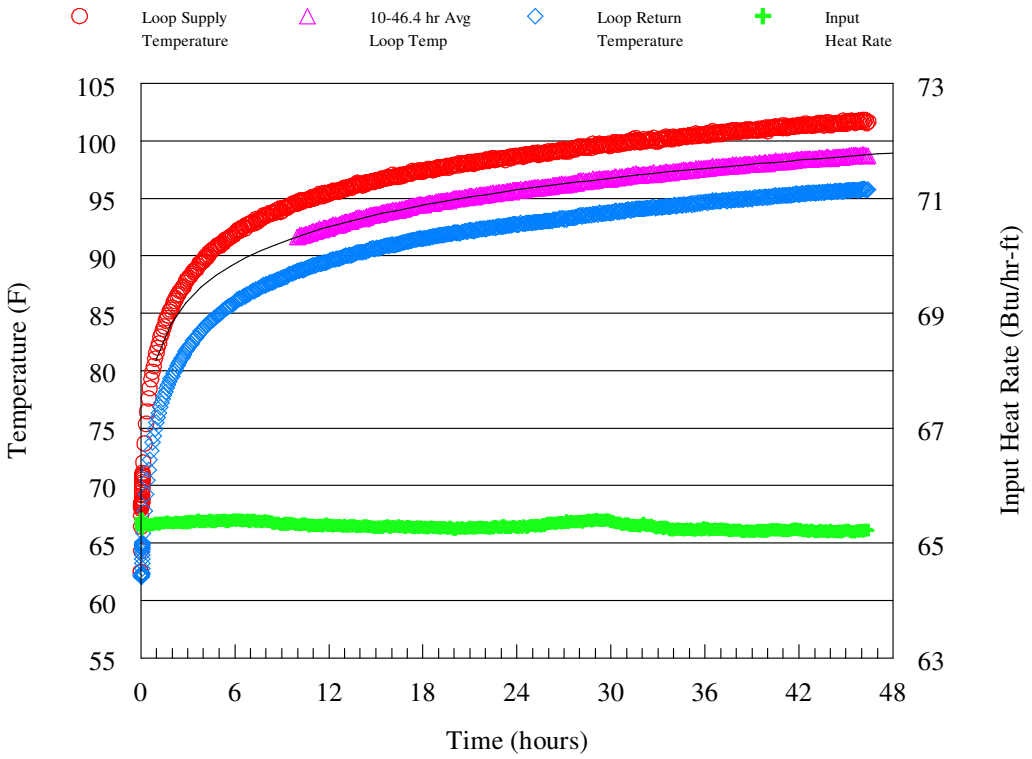


FIG. 1: TEMPERATURE & HEAT RATE DATA VS TIME

Figure 1 above shows the loop temperature and heat input rate data versus the elapsed time of the test. The temperature of the fluid supplied to and returning from the U-bend are plotted on the left axis, while the amount of heat supplied to the fluid is plotted on the right axis on a per foot of bore basis. In the test statistics below, calculations on the power data were performed over the analysis time period listed in the Line Source Data Analysis section.

SUMMARY TEST STATISTICS

Test Date	June 12-14, 2013
Undisturbed Formation Temperature	Approx. 60.8-61.8°F
Duration	46.4 hr
Average Voltage	231.4 V
Average Heat Input Rate	19,583 Btu/hr (5,738 W)
Avg Heat Input Rate per Foot of Bore	65.3 Btu/hr-ft (19.1 W/ft)
Calculated Circulator Flow Rate	6.6 gpm
Standard Deviation of Power	0.08%
Maximum Variation in Power	0.22%

LINE SOURCE DATA ANALYSIS

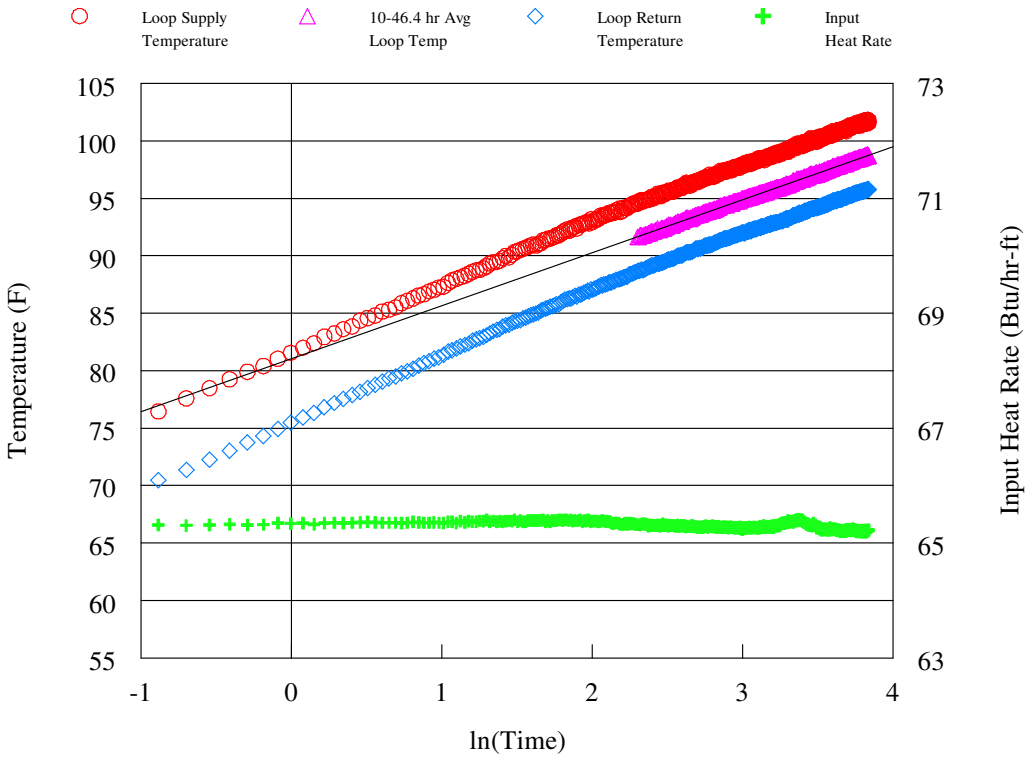


FIG. 2: TEMPERATURE & HEAT RATE VS NATURAL LOG OF TIME

The loop temperature and input heat rate data versus the natural log of elapsed time are shown above in Figure 2. The temperature versus time data was analyzed using the line source method (see page 3) in conformity with ASHRAE and IGSHPA guidelines. A linear curve fit was applied to the average of the supply and return loop temperature data between 10 and 46.4 hr. The slope of the curve fit was found to be 4.62. The resulting thermal conductivity was found to be **1.12 Btu/hr-ft-°F**.

THERMAL DIFFUSIVITY

The reported drilling log for this test borehole indicated that the formation consisted of clay, shell and sand. A weighted average of heat capacity values based on the indicated formation was used to determine an average heat capacity of 32.7 Btu/ft^3-°F for the formation. A diffusivity value was then found using the calculated formation thermal conductivity and the estimated heat capacity. The thermal diffusivity for this formation was estimated to be **0.83 ft^2/day**.

CERTIFICATE OF CALIBRATION

GRTI maintains calibration of the datalogger, current transducer and voltage transducer on a biannual schedule per the manufacturers recommendations. The components are calibrated by the manufacturer using recognized national or international measurement standards such as those maintained by the National Institute of Standards and Technology (NIST).

FTC Unit 217

DA Unit 64

PRIMARY EQUIPMENT		
COMPONENT	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Datalogger	10/4/2012	10/4/2014
Current Transducer	8/24/2012	8/24/2014
Voltage Transducer	8/24/2012	8/24/2014

GRTI periodically verifies the combined temperature sensor/datalogger accuracy via a water bath. Temperature readings are simultaneously taken with a digital thermometer that has been calibrated using instruments traceable to NIST.

DATE	1/29/2013			
THERMOCOUPLE 1 (°F)	31.7 31.7 31.7			
THERMOCOUPLE 2 (°F)	31.6 31.6 31.6			
THERMOCOUPLE 3 (°F)	31.6 31.7 31.7			
THERMOCOUPLE 4 (°F)	31.7 31.7 31.7			
DIGITAL THERMOMETER (°F)	31.9 31.9 31.9			

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SECTION 012100 – ALLOWANCES

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 governing allowances. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change order.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly upon delivery for damage or defects.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with relative materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Types of allowances include the following:

Allowance No. 1: Include in the base bid the cost to over excavate and fill with engineered fill an additional 50 cubic yards, in addition to the amount shown on the drawings. If this allowance is not used, or only used in part, the Owner will be reimbursed by way of a credit change order based on the price bid for this work in the unit price section of the Contractor's bid. Removal and replacement of areas exceeding the 50 cubic foot allowance will be added to the Contract's Contract, via change order, and based on the Contractor's bid

unit price. There will be no consideration for additional time to accomplish this work because it is included in the base bid but additional time may be considered for replacement in excess of the allowance area.

Allowance No. 2: Include in the project base bid the cost of replacing 500 board feet of dimensional wood replacement (i.e. 2x4, 2x6, 2x8, etc.) not included in the base contract. Any portion of the allowance not used will be credited to the Owner, via change order, based on the unit price established in the Contractor's bid.. Removal and replacement of areas exceeding the 500 board feet allowance will be added to the Contract base, via change order, and based on the Contractor's bid unit price. There will be no consideration for additional time to accomplish this work because it is included in the base bid but additional time may be considered for wood replacement in excess of the allowance area.

Allowance No. 3: Include in the project base bid the cost of providing 200 square feet of liquid flashing system in the areas of limited ponding. Any portion of the allowance not used will be credited to the Owner, via change order, based on the unit price established in the Contractor's bid. The cost of providing 200 square feet of liquid flashing system will be added to the Contract via change order, and based on the Contractor's bid unit price. There will be no consideration for additional time to accomplish this work because it is included in the base.

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

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 specifies administrative and procedural requirements for unit prices.

B. A unit price is an amount proposed by Bidders and stated on the Bid Form as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order in the event the estimated quantities of Work required by the Contract Documents are increased or decreased.

C. Unit prices include all necessary material, overhead, profit and applicable taxes.

D. The Owner reserves the right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this Work measured by an independent surveyor acceptable to the Contractor at the Owner's expense.

E. **Contractor shall not proceed with work listed herein that will incur charges beyond what is included in the Original Contract Price of this job without specific authorization by the Owner, or such method approval as he shall deem acceptable.**

F. Schedule: A "Unit Price Schedule" is included below. Specification Sections referenced in the Schedule contain requirements for materials and methods described under each unit price.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 UNIT PRICE SCHEDULE

A. Unit Price 1 – Over Excavate and Backfill with Approved Engineered Soil – Material and labor.

1. Description: Excavation of Unsuitable Material includes removal of any

material deemed unsuitable for construction purposes, by the Owner's Representative, from the job site and legal disposal thereof (per cubic yard). Backfill of Undercut Areas includes the furnishing, installation and compaction of soil acceptable to the Owner's Representative.

a. Unit of Measurement: Cubic yard of excavated material.
b. Unit of Measurement: Cubic yard of approved fill material.

B. Unit Price 2 – Provide dimensional wood replacement- Labor and Material

1. Description: Replacing a board foot of dimensional wood replacement.
   a. Unit of Measurement: Board foot of damaged wood.

C. Unit Price 3 – Provide liquid flashing system in small ponding areas Labor and Material

1. Description: Provide liquid flashing system in small ponding areas. After the 200 SF allowance in the base bid has been used.

   a. Unit of Measurement: Square foot of roof coated in excess of Contract requirements and allowances.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1- Alternate 1 changes the base bid HVAC system to a complete and functioning water source variable refrigerant flow (VRF) system with decoupled ventilation utilizing a geothermal well field as the heat sink. The classroom HVAC units shall be provided as ceiling cassettes with a ducted concealed unit provided in the corridor. The VRF piping, heat recovery units and system components indicated in the Contract Documents shall be installed in accordance with the manufacturer's recommendations. The VRF system shall be City-Multi as manufactured by Mitsubishi with not substitutions.

B. Alternate No. 2- Alternate 2 encloses the existing covered breezeway between the east end of the existing school and the existing gymnasium. This work will not commence until school has recessed for the summer in 2014 and must be completed by August 15, 2014.

END OF SECTION 012300

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
2. Division 01 Section "Unit Prices" for administrative requirements for using unit prices.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.

2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Contractor must coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.

B. Each Sub-Contractor shall coordinate preparation of this Schedule of Values for its part of the Work with preparation of the General Contractors' Construction Schedule and Schedule of Values.

C. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:

1. Contractor's construction schedule.
2. Application for Payment form.
3. List of subcontractors.

D. Submit the Schedule of Values to the Architect at the earliest feasible date, but in no case later than 14 days before the date scheduled for submittal of the initial Application for Payment.

E. Format and Content: The project Schedule of Values shall include but is not limited to the following line items; Provide separate lines for labor and material values for items w/ a asterisk before them:

1. Division 1
   a. Superintendent
   b. Bond
   c. Insurances
   d. Shop Drawings
   e. Equipment
   f. Dumpster
   g. Utilities
   h. Temporary Facilities
   i. Final Clean up

2. Division 2
    a. Site Clearing
    b. Site Demolition
    c. Earth Moving
    d. *Erosion & Sediment Controls
    e. *Reinforced Earth
    f. *Bituminous Paving
    g. *Site Concrete
    h. *Piping and Storm Structures
    i. *Filterra Structures
    j. *Water Piping and Fire Hydrants
    k. *Underground Storm Water Retention
    l. *Finish Grading and Seeding
    m. Selective Building Demolition
    n. Selective Roof Demolition
    o. Clear & Grub the Building Site
    p. *Building Pad
    q. *Footing Excavation

3. Division 3
    a. *Concrete Footings
    b. *Footing Reinforcing
    c. *Concrete Slab on Grade
    d. *Slab Reinforcing and Accessories
    e. *Elevated Concrete Slab

4. Division 4
    a. *Block Foundation Walls
    b. *Foundation Wall Reinforcing
    c. *Block Walls
    d. *Block Wall Reinforcing
    e. *Wall Grout
    f. *Brick
    g. *Masonry Ties & Reinforcing
    h. *Damp Proofing
    i. *Cavity Wall Insulation
    j. *Plastic Sheet Through Wall Flashing
    k. Masonry Cleaning.

5. Division 5
    a. *Structural Steel
    b. *Bar Joists
    c. *Metal Roof and Form Deck
    d. *Loose Steel Lintels
    e. *Cold Formed Metal Framing and Furring

6. Division 6
    a. *Roof Blocking
    b. *Wood Soffits
    c. *Casework
    d. *Plastic Laminate Countertops and Splashes
    e. *Solid Surface Material Window Sills

7. Division 7
    a. *Building Insulation
    b. *Architectural Wall Panels
    c. *Two-Ply Cold Applied Modified Bitumen Roof Membrane
    d. *Roof Insulation
    e. *Flashing & Sheet Metal
    f. *Sealants
    g. *Fire Safing Sealants and Sleeves

8. Division 8
    a. *Hollow Metal Doors & Frames
    b. *Wood Doors
    c. *Finish Hardware
    d. *Aluminum Storefront Windows
    e. *Glazing

9. Division 9
    a. *Non-Structural Cold Formed Metal Framing
    b. *Gypsum Wall Board
    c. *Wall Base
    d. *Vinyl Composition Floor Tile
    e. *Ceramic Floor and Wall Tile
    f. *Acoustical and Translucent Ceiling Panels
    g. *Interior Painting
    h. *Exterior Painting

10. Division 10
    a. *Marker & Display Boards
    b. *Toilet Partitions
    c. *Toilet Accessories
    d. *Fire Extinguisher Cabinets
    e. *Control Joint Covers
    f. *Walk-Off-Mat
    g. *Roller Shades

11. Division 15 Mechanical
    a. *Plumbing Demolition
    b. *Underground Piping Rough-in
    c. *Aboveground Piping Rough-in
    d. *Pipe Insulation

e. *Plumbing Fixtures
f. *Underground Gas Piping
g. *Aboveground Gas Piping
h. *Grease Trap
i. *Water Heater
j. *Backflow Preventer

k. *Water Source Heat Pumps
l. *WSHP Ductwork
m. *Inline Pumps
n. *Piping Accessories
o. *Ventilation Unit
p. *Ventilation Ductwork
q. *Volume Dampers
r. *Ductwork Insulation
s. *Diffusers, Registers and Grilles
t. *Fire Dampers
u. *Exhaust Fans
v. *Automatic Temperature Controls
w. *Geothermal Bore (including HPDE)

Alternate 1
a. *City Multi System (including controls)
b. *Inline Pumps
c. *Gas Piping
d. *Piping
e. *Piping Accessories
f. *Ventilation Unit
g. *Ventilation Ductwork
h. *Volume Dampers
i. *Ductwork Insulation
j. *Diffusers, Registers and Grilles
k. *Fire Dampers
l. *Exhaust Fan
m. *Automatic Temperature Controls
n. *Geothermal Bore (including HPDE)

Alternate 2
a. *Mini-Split System

11. Division 16
a. Electrical Demolition
b. *Underground Conduit
c. *Underground Conductors
d. *Lighting Rough-in
e. *Power Rough-in
f. *Fire Alarm Rough-in
g. *Clock Rough-in
h. *Intercom Rough-in

i. *HVAC Equipment Rough-in
j. *Plumbing Equipment Rough-in
k. *Security Rough-in
l. *Mobilization
m. *Demobilization
n. *Raceways
o. *Branch Conductors
p. *Sub-meters
q. *Panel Boards
r. *Wiring Devices
s. *Cable Tray
t. *Final Mechanical Connections
u. *Final Plumbing Connections
v. *Trim-out

*Provide separate material and labor values.

F. If Alternate #1 is accepted provide a separate schedule of values for that work. Use the base bid Schedule of Values line item list as appropriate for the line items in the Alternate SOV.

G. If Alternate #2 is accepted provide a separate schedule of values for that work. Use the base bid Schedule of Values line item list as appropriate for the line items in the Alternate SOV.

H.

1.4 Identification:

A. Include the following Project identification on the Schedule of Values:

1. Project name and location.
2. Name of the Architect.
3. Project number.
4. Contractor's name and address.
5. Date of submittal.

B. **Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum**.

C. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT:

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

B. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

C. Payment Application Times: Each Application for Payment shall be submitted by the first day of each month. The period of construction Work covered by each Application for Payment is the period from the first to the last day of each month for the duration of the construction period.

D. Payment Application Forms: Use AIA Document G 702 and Continuation Sheets G 703 as the form for Application for Payment.

E. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

F. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.

G. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

H. Transmittal: Submit 4 executed copies of each Application for Payment to the Architect by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien and similar attachments.

I. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Architect.

J. Waiver Delays: Submit each Application for Payment with the Contractor's waiver of mechanics lien for the period of construction covered by the application.

K. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of Work covered by the application who could lawfully be entitled to a lien.

L. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Owner.

M. Initial Application for Payment: Administrative actions and submittals that must precede submittal of the first Application for Payment include the following:

1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule (preliminary if not final).
5. Copies of building permits

N. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this

application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

O. Administrative actions and submittals that shall **precede** this application include:

1. Occupancy permits and similar approvals.
2. Final cleaning.
3. Application for reduction of retainage, and consent of surety.
4. Advice on shifting insurance coverage.
5. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.
6. All warranties and guarantees.

P. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required Project construction records to Owner.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish and similar elements.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 012900

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SECTION 013100 - PROJECT MEETINGS

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 specifies administrative and procedural requirements for project meetings including:

1. Pre-Construction Meeting.
2. Progress Meeting(s)
3. Roofing Manufacturer's Pull-out Test Meeting
4. Final Inspection Meeting

B. Construction schedules are specified in Section 01300 - "Submittals"

C. Pre-construction Conference An organizational meeting will be held at the Project site prior to commencement of construction activities to clarify responsibilities and procedures as outlined below.

D. Agenda: Topics will include items of significance that could affect progress of the job, such as:

1. Contractor's schedule and work plan including staffing.
2. Estimated time of completion and critical path items.
3. Deliveries, site access, and storage of materials.
4. Off-site fabrication issues.
5. Site Utilization, Temporary Facilities.
6. Hours of Work and Job Safety.
7. Hazards and risks.
8. Quality, Work standards and cleanup.
9. Handling of deck replacement-quantification and approval.
10. Change Orders and RFP procedures.
11. Documentation for (and handling of) payment requests.
12. Responsibility and Authority of Field Representatives
13. Distribution of phone names and numbers of all present
14. Substantial Completion, Rain Days, Liquidated Damages

E. Attendees: The Owner, the Architect, the Contractor and his superintendent, and a representative of the Roofing Manufacturer shall each be at the conference.

1.3 PROGRESS MEETINGS

A. Progress meetings will be held at the Project Site **twice a month** for the purpose of reviewing job progress.

1. Attendees: The Architect, the Contractor and his superintendent, and any subcontractor or supplier whose performance will have an impact on the quality or timeliness of job completion will be present at this meeting. The Subcontractor's representative at these meetings shall be familiar with the project and authorized to make decisions on matters relating to job progress.

2. Agenda: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule: whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions or overtime work will be required to ensure that current and subsequent activities will be completed within the Contract Time.

3. Review the present and future needs of each entity present, including such items as:

a. Time and Sequences
b. Deliveries and critical path items
c. Off-site fabrication issues
d. Access
e. Temporary facilities and services
f. Hours of Work
g. Hazards and risks
h. Quality, Work standards and cleanup
i. Change Orders and unit price work done to date
j. Documentation of information for payment requests
k. Review Applications for Payment with the General and Key Subcontractors.

B. Schedule Updating: Revise the construction schedule once a month after the mid-month progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule every month.

C. Final Inspection Meeting: After the work is complete, there shall be a final meeting at the project site to examine the roof, verify all work is complete and all requirements are met for issuing contractor and manufacturer's warranties to the Owner.

1. Attendees: The Owner, the Architect, the Contractor and his superintendent, and a representative of the roofing manufacturer shall be at the meeting.

PART 1 - PRODUCTS (Not Applicable)

PART 2 - EXECUTION (Not Applicable)

END OF SECTION 013100

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SECTION 013300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:

1. Submittal Schedule
2. Contractor's construction schedule
3. Shop Drawings
4. Product Data
5. Samples
6. Schedule of Values

1.3 Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals.

1.4 SUBMITTAL SCHEDULE

A. The Contractor shall prepare a complete schedule of submittals. Submit the schedule within 10 days of the date required for establishment of the Contractor's construction schedule.

1. Coordinate submittal schedule with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.

2. Prepare the schedule in Specification Division order using the schedule shown at the end of this section as a template. Provide the following information for each submittal:

a. Submittal reference number for each item.
b. Review Status
c. Name of subcontractor.
d. Description of the part of the Work covered.

3. Scheduled date for resubmittal.

1.5 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. **Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay**.

B. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

D. Allow two weeks for initial review. If possible, review will be done more quickly. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect will promptly advise the Contractor when a submittal being processed must be delayed for coordination. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

E. Submittal Preparation: Place a permanent label, title block or cover sheet on each submittal for identification. Indicate the name of the entity that prepared each submittal.

1. Provide a space approximately 4" x 5" on the label, title block or cover sheet on Submittal to record the Architect's review and approval markings and the action taken. Include the following information on the label, title block or cover sheet, for processing and recording action taken.

    a. Project name and date
    b. Name and address of Contractor and Supplier
    c. Number and title of appropriate Specification Section
    d. Drawing number and detail references, as appropriate

F. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the contractor will be returned without action.

1. On the transmittal, record relevant information and requests for data including submittal number and description (Note: Description should include whether it is product data or a shop drawing and what material it relates to, i.e. paint, roofing, sheet metal, etc.). On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. **Include Contractor's certification that information complies with Contract Document requirements. If submittal comes without this certification, it will be returned without review.**

G. Transmittal Form: Use AIA Document G810 or an approved equal.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Submission before the Pre-Construction Meeting: Prepare a simple horizontal bar-chart type Contractor's construction schedule. Submit **before** the preconstruction conference.

1. Provide a separate time bar for each significant construction activity. Provide continuous vertical line to identify the first working day of each week.

2. Prepare the schedule on a sheet, of sufficient width to show data for the entire construction period.

3. Show each activity in proper sequence, and highlight critical path items.

4. Plan for completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. Schedule Updating: Revise the schedule after the progress meeting or at times where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting or when submitting a Request for Payment.

1.7 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. Shop Drawings include fabrication and installation drawings, schedules, and similar drawings. Include the following information:

1. Dimensions
2. Identification of products and materials included
3. Compliance with specified standards
4. Notation of coordination requirements
5. Notation of dimensions established by field measurement

C. Sheet size: Submit Shop Drawings on sheets at least 8-1/2" x 11" but no larger than 24" x 36".

D. Submittal: Submit seven copies of all shop drawings for review. For shop drawings submitted in format larger than 8-1/2x11, submit one reproducible copy and three prints. The Architect will retain two, and will return the others marked with action

taken and corrections or modifications required. (One of these two copies shall be marked up and maintained as a Record Document in the Architect's file. The remaining copy will be distributed to the Owner upon Project Closeout.) One copy of the submittal is forwarded to the Owner with action taken and the remaining copies are forwarded to the Contractor. See Section 01700, "Project Closeout" for additional information on Record Document requirements.

E. Do not use Shop Drawings for construction unless they have been reviewed and approved by the Architect.

1.8 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, etc. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings".

B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

1. Submittal number
2. Specification division
3. Manufacturer's printed recommendations
4. Compliance with recognized trade association standards
5. Compliance with recognized testing agency standards
6. Application of testing agency labels and seals
7. Notation of dimensions verified by field measurement

C. Do not submit Product Data until compliance with requirements of the contract Documents has been confirmed. Stamp and sign data after reviewing it for compliance to indicate that such a review has been made and that the data does indeed comply with the specified requirements.

D. Submittals: Submit 7 copies of each required submittal; The Architect will retain two and will return the others marked with action taken and corrections or modifications required.

E. Distribution: Furnish copies of approved submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms. Do not proceed with installation until an applicable copy of Product Data is in the installer's possession. Do not permit use of unmarked copies of Product Data in connection with construction.

1.9 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's Sample. Include the following:

1. Generic description of the Sample
2. Product name or name of manufacturer
3. Compliance with recognized standards

B. Submit Samples for review of kind, color, pattern and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.

C. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, submit 4 sets; one will be retained marked with the action taken. Maintain at least one set of Samples, as returned, at the Project site, for quality comparisons throughout the course of construction.

D. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1.10 SCHEDULE OF VALUES

A. Submit a schedule of values along with other product submittals consisting of a tabular breakdown of individual elements of the work in sufficient detail to be able to pay for individual items and see where the costs are. Include the project name and address, Contractor's name and address, Contract Purchase Order number, etc. and show the breakdown of what percentage of the total job cost is in each line item. This breakdown will be used for Applications for Payment. Include administrative items such as bond and supervision, insurance, etc. as applicable.

B. The Schedule of Values must be submitted a minimum of two weeks before the Contractor intends to submit their first application for payment. This is to allow time for the schedule of values to be reviewed and approved by the Owner before the initial invoice. Failure to comply with this requirement will be cause to refuse the application.

C. Application for payment must be based upon the approved schedule of values and submitted on AIA Application for Payment Forms G702 and G703, only. State

of Virginia forms will not be accepted.

1.11 ARCHITECT'S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect will review each submittal, mark to indicate action taken, and return promptly. **Compliance with specified characteristics is the Contractor's responsibility.**

B. Action Stamp: The Architect will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

C. Reviewed: Where submittals are marked "Reviewed" that part of the Work covered by the submittal may proceed provided it complies with requirements of the contract Documents; final acceptance will depend upon that compliance.

D. Comments Attached: When submittals are marked "Comments Attached," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance. If resubmittal is also required, promptly respond, in order to acknowledge that requested changes will be made.

E. Rejected: When submittal is marked "Rejected" and "Resubmit" do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked "Rejected" and "Resubmit" to be used at the Project site, or elsewhere where Work is in progress.

F. Confirm: Where a submittal is marked "Confirm" the comment indicates an "approved as noted" status and the Contractor must confirm to the Architect in writing that they will comply with the "as noted" comments before proceeding with that part of the Work.

G. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Reviewed".

PART 2 - PRODUCTS (Not Applicable)

PART 3 - PART 3 - EXECUTION (Not Applicable)

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES

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 specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary construction and support facilities required include but are not limited to:

1. Water service and distribution
2. Temporary electric power and lights
3. Storage facilities for construction materials.
4. Sanitary facilities, including drinking water.
5. Waste disposal services.

C. Power and water are available at the schools for no cost to the Contractor. However, the Contractor shall make all necessary connections and distribution to serve the project. The Contractor shall remove distribution and connection at the conclusion of the work.

D. Security and protection facilities required include but are not limited to:

1. Temporary fire protection.
2. Barricades, warning signs, lights.
3. Environmental protection.

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Police, Fire Department and Rescue Squad rules.
4. Environmental protection regulations.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

C. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.

1.4 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site. Remove asphalt mops from roof at the end of each working day.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures provide translucent nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.

1. For tarpaulins to protect from Asphalt spills on the interior of the building provide tarpaulins that resist melting when exposed to hot asphalt. These tarpaulins should only be used over critical care items i.e. Computers, Telephones Televisions, etc.

B. Drinking Water Facilities: Provide containerized tap-dispenser bottled-water type drinking water units, including paper cup supply.

C. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material, and supply unit(s) with toilet tissue.

D. First Aid Supplies: Comply with governing regulations.

E. Fire Extinguishers: Provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures, Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed.

C. Locate storage trailers, sanitary facilities and other temporary support facilities for easy access, and where approved by the Owner.

D. Maintain temporary support facilities until Substantial Completion, or until personnel will no longer be working on the roof.

E. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

F. Toilets: Install self-contained toilet units in a location approved by the Owner. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted. Have toilets regularly serviced to keep them clean and in good condition.

G. Collection and Disposal of Waste and Demolition Debris: Collect waste from construction areas and elsewhere daily and remove construction debris from the site weekly or as soon as containers are nearly fully. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste by containerizing properly. Dispose of material in a lawful manner.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Temporary Fire Protection: Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations." Locate fire extinguishers near tankers and kettles and on the roof during roofing operations.

B. Barricades: Provide temporary barricades where roofing operations are going on to keep children away.

C. Security: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Remove all equipment from around the building at the end of each working day that would provide a means of egress

to the roof, and lock up building at days end.

D. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.3 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility at Substantial Completion.

END OF SECTION 015000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Final Property Survey: Submit 4 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to the Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place 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.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place 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.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concret] and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion

of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

H. 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 practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place 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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017400 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED PRODUCTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division - 1 Specifications Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.

B. General closeout requirements are included in Section "Project Closeout"

C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Divisions-2 through -16.

D. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product and installation warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor. **Acceptance of this Contract will constitute acceptance of the warranty and guarantee terms specified herein notwithstanding any printed information in the manufacturer's standard literature, or claims for exception expressed after signing of the Contract.**

1.3 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The term and the conditions of the reinstated warranty shall be equal to the original warranty (the original terms shall apply).

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service

life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.4 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

B. Forms for special warranties are included at the end of Section 075323. Prepare a written document utilizing the appropriate form, ready for execution by the contractor and manufacturer.

C. Refer to individual Sections of Division-3 through -33 for specific content requirements, and particular requirements for submittal of special warranties.

D. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

E. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-12" by 11" paper.

F. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS, the project title, date of Substantial Completion, and the name of the Contractor".

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 017400

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SECTION 017700 - PROJECT CLOSEOUT

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 specified administrative and procedural requirements for project closeout, including:

1. Establishment of Substantial Completion
2. Final Acceptance
3. Inspection procedures
4. Project record document submittal
5. Submittal of warranties
6. Final cleaning and Repairs

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions-1 through 33.

1.3 SUBSTANTIAL COMPLETION

A. General: **It is the Contractor's responsibility to initiate procedures for obtaining a Certificate of Substantial Completion. This date of Substantial Completion must be before the expiration of the Contract Time, or liquidated damages will be assessed. At Substantial Completion, all work must be complete with the exception of punch list items. "Substantial Completion" is defined in AIA 201.**

B. Preliminary Procedures: Before requesting inspection for Certificate of Substantial Completion, complete the following. List exceptions in the request.

C. Make a "punchlist" of items needing corrective action. This list should be thorough and list all items required to achieve Final Completion. **Failure to provide a complete punchlist will be grounds for the withholding of the Certificate of Substantial Completion**. Punchlist items relate to work accomplished but requiring correction or modification to satisfy the project requirements. **Work that is incomplete shall not be included on the punchlist for substantial completion and shall be completed prior to initiating substantial completion procedures**.

D. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. If not already provided, include

supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

E. Submit specific warranties and guarantees, final certifications, and similar documents

F. Advise Owner of pending insurance changeover requirements.

G. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

H. Submit record drawings, and similar final record information.

I. Complete final clean up requirements, including the restoration of any damage to the building or site which occurred during the course of construction.

1.4 INSPECTION PROCEDURES

A. On receipt of a request for inspection, the Architect will either proceed with inspection or advise the Contractor of unfilled requirements. The Architect will prepare the Certificate of Substantial Completion following inspection, if aforementioned requirements are met, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued. The Architect will repeat inspection when requested and assured that the Work has been substantially completed. Results of the completed inspection will form the basis of requirements for final acceptance. Coordinate, if possible, this inspection with the Post-Application Roofing Conference as outlined in Section 01200, "Meetings".

1.5 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

B. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

C. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

D. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect.

E. Submit consent of surety to final payment.

F. Submit a final liquidated damages settlement statement, if applicable.

G. Reinspection Procedures: The Architect will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect. Upon completion of reinspection, the Architect will prepare a certificate of final acceptance, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance. If necessary, reinspection will be repeated. **If more than one inspection is needed following the issuing of the Certificate of Substantial Completion, an amount of $680 will be deducted from the amount owed the Contractor for each subsequent inspection required of the Architect to verify that the Contractor's work is completed**.

1.6 RECORD DOCUMENT SUBMITTALS

A. Record Documents: See Section 017839 for Record Documents requirements and procedures

1.7 SUBMITTAL OF WARRANTIES

A. Submit two copies of the Roof Manufacturers warranty and two copies of the Roof Contractor warranty.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 FINAL CLEANING AND REPAIRS

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".

B. Cleaning: Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion:

C. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances caused by construction operations. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that

are neither paved nor planted, to a smooth even-textured surface.

D. Clean all exposed building components, whether existing or new of any stains or spills that occurred during construction.

E. Repairs: Repair any damage to the property caused by construction operations to condition prior to start of construction in accordance with requirements of these specifications. Fill any holes or ruts created during construction with topsoil and reestablish grass in these and any other areas where grass has been damaged during the course of the work.

F. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

G. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, materials, and finishes as well as systems and equipment.

B. Related Sections include the following:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit **3** draft copies of each manual at least **15** days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return **one copy** of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit two **copies**] of each manual in final form at least **15** days before final inspection. Architect will return copy with comments within **15** days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit **3** copies of each corrected manual within **15** days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of

equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.

4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or

supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:

1. Division 01 Section "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
2. Division 01 Section "Closeout Procedures" for general closeout procedures.
3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. Architect will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return plots and prints for organizing into sets, printing, binding, and final submittal.

b. Final Submittal: Submit one set of marked-up Record Prints, one set of Record CAD Drawing files, one set of Record CAD Drawing plots, and three

copies printed from record plots. Plot and print each Drawing, whether or not changes and additional information were recorded.

1) Electronic Media: CD-R.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: 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 would be difficult to identify or measure and record 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.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.

m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Transparencies: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect the Owner's Representative When authorized, prepare a full set of corrected transparencies of the Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on Record Prints. Erase, redraw, and add details and notations where applicable.
2. Refer instances of uncertainty to Architect for resolution.
3. Owner will furnish Contractor one set of transparencies of the Contract Drawings for use in recording information.
4. Print the Contract Drawings and Shop Drawings for use as Record Transparencies. Architect will make the Contract Drawings available to Contractor's print shop.

C. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect When authorized, prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:

1. Format: Same CAD program, version, and operating system as the original Contract Drawings.
2. Format**:** DWG Version operating in Microsoft Windows operating system.
3. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. The Owner will furnish Contractor one set of CAD Drawings of the Contract Drawings for use in recording information.

a. Architect makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
b. CAD Software Program: The Contract Drawings are available in AutoCad 2011.

D. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

E. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications 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. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

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 Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

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SECTION 019100 - SPECIAL INSPECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Special inspections for earthwork, concrete, masonry and structural steel.

1.2 REFERENCES

A. 2009 International Building Code
B. Virginia Uniform Statewide Building Code

1.3 SUBMITTALS

A. Submittals required for special inspections are included in the following specification sections:

1. Concrete.
2. Masonry.
3. Structural Steel.

1.4 TESTING AGENCIES AND SPECIAL INSPECTOR.

A. Except where noted otherwise, the Owner will retain an independent testing agency to complete the testing where indicated in the specifications.

1.5 STATEMENT OF SPECIAL INSPECTIONS:

A. Initial Submittal: The statement of special inspections is required by the International Building Code to be submitted by the permit applicant prior to obtaining building permit. Contractor shall obtain a signed copy of the statement of special inspection from the Structural Engineer of Record to be submitted to the City Building Official for review.

B. Interim Submittals: Special inspector will submit quarterly interim submittals to the County Building Official as required by the IBC. Interim submittals will note which items have been completed and note any deficiencies.

C. Final Submittal: At the completion of the special inspections, and after all discrepancies noted have been corrected, the special inspector will submittal a final report of special inspections to the City Building Official.

1.6 PAYMENT FOR ADDITIONAL SERVICES:

1.6.1 DISCREPANCIES: Contractor shall correct any discrepancies or non-conformance to the specified requirements identified during special inspections.

A. RETESTING: Retesting required because of non-conformance to specified requirements shall be performed by the Owner's testing agency. Payment for retesting will be charged to the Contractor.

END OF SECTION 019100

HAMPTON ROADS AREA STATEMENT OF SPECIAL INSPECTIONS

PROJECT
Seaford Elementary School Addition
1105 Seaford Road
Seaford, Virginia 23696

PERMIT APPLICANT

PRIMARY RDP OF RECORD
Craig Hudson, AIA
Hudson + Associates
120 West Queens Way, Suite 201
Hampton, VA 23669
757-722-1964

STRUCTURAL ENGINEER OF RECORD
Kevin M. Roomsburg, PE
NRW Engineering, PC
748 Lord Dunmore Dr., Suite 101
Virginia Beach, VA 23464
757-474-0612

This Statement of Special Inspections is submitted as a condition for permit issuance in accordance with the International Building Code (IBC) as stated in the Virginia Uniform Statewide Building Code (USBC). It includes a Schedule of Special Inspections applicable to this project as well as the name of the Special Inspector, and the identity of other testing laboratories or agencies intended to be retained for conducting these inspections or tests.

The Special Inspector shall keep records of all inspections, and shall furnish inspection reports to the Building Official, appropriate Registered Design Professional(s) (RDP(s)), Owner, and Contractor. All discrepancies shall be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and appropriate RDP(s). Interim reports shall be submitted to the Building Official, Owner, Contractor, and the appropriate RDP(s) according to the *Hampton Roads Regional Special Inspection Guidelines and Procedures.*

Jobsite safety is solely the responsibility of the contractor. Materials and activities to be inspected are not to include the contractor's equipment and methods used to erect or install the materials listed. **All fees/costs related to the performance of Special Inspections shall be the responsibility of the Owner. Additionally, the undersigned (RDP or SER) are only acknowledging that the items enumerated on the Schedule of Special Inspections are consistent with the required design elements, the applicable sections of the Uniform Statewide Building Code, and their area of expertise.**

REVIEW, AUTHORIZATION & ACCEPTANCE

Permit Applicant (*If not Owner*)**:**

Signature / date: _____

Print Name: _____

Owner's Authorization (*If other than applicant*)**:**

Signature / date: _____

Printed Name: _____

Primary RDP of Record:
(Review and Acceptance of Schedule)

Signature / date: _____

Print Name: Craig Hudson

SER of Record:
(Review and Acceptance of Schedule)

Signature / date: 9-10-13

Printed Name: Kevin M. Roomsburg

Building Official's Acceptance:

Signature / date: _____

Printed Name: _____

SCHEDULE OF SI PREPARED BY:

Virginia RDP Seal of SI Preparer

Kevin M. Roomsburg
Printed Name of the Preparer of the Schedule (on line above)

Special Inspector:

Signature / date: 9-10-13

Printed Name: Kevin M. Roomsburg

SI Company Name: NRW Engineering, P.C.

SCHEDULE OF SPECIAL INSPECTIONS

MATERIAL/ACTIVITY	TYPE OF INSPECTION	APPLICABLE TO THIS PROJECT			
		Y/C/P/N	EXTENT/REFERENCE	AGENT	COMPLETED
GENERAL					
Pre-construction conference	Meeting with parties listed in Section 6 of HRRSIGP to discuss Special Inspection procedures	Y	Scheduled by SI with the Contractor prior to commencement of work	1/2	
EARTHWORK					
Site preparation (building)	Field testing and inspection	Y	Field Review: IBC 1704.7	2	
Fill material (building)	Review submittals, field testing and inspection	Y	Laboratory Testing: Field Review: IBC 1704.7	2	
Fill compaction (building)	In-place density tests	Y	Laboratory Testing: Field Review: IBC 1704.7	2	
Foundation sub-grade	Field inspection of foundation subgrade prior to placement of concrete	Y	Field Review: IBC 1704.7	2	
PILE/DRILLED PIER FOUNDATIONS					
Materials	Review product, sizes and lengths	N	IBC 1704.8/Table 1704.8		
Test piles	Monitor driving of test piles	N	IBC 1704.8/Table 1704.8		
Pile/drilled pier installation	Monitor drilling, placement, driving of piles, including cut off and tip elevations	N	IBC 1704.8/Table 1704.8, Table 1704.9		
Pile load test	Monitor pile load test	N	IBC 1704.8/Table 1704.8		
CONCRETE					
Materials	Review product supplied versus certificates of compliance and mix design	Y	Submittal & Field Review: IBC 1704.4.1, ACI 318: Ch. 4 and 5, IBC 1904-2.2, 1913.2, 1913.3	1	
Installation of reinforcing steel, including prestress tendons and anchor bolts as well as welding	Field inspection of placement	Y	Field Review: ACI 318:3.5, 3.5.2 & Chapter 7, AWSD1.4; IBC 1704.4,1911.5, 1913.4	1/2	
Formwork installation	Field inspection	Y	Field Review: ACI 318:6.1.1, IBC 1704.4	1/2	
Concreting operations & placement	Field inspection of placement/sampling	Y	Field Review: ACI 318:5.6, 5.8,5.9-10; ASTM C172, C31; IBC 1704.4, 1913.6, 1913.7,1913.8, 1913.10	2	
Concrete curing	Field inspection of curing process	Y	Field Review: ACI 318: 5.11-13, IBC 1704.4, 1913.9	2	
Concrete strength	Evaluation of concrete strength	Y	Laboratory Testing: ACI 318; 6.2; IBC 1704.4	2	
Application of forces for prestressed concrete	Field inspection	N	Field Review: ACI 318: 18.20		
Grouting of prestress tendons	Field inspection	N	Field Review: ACI 318: 18.18.4		

MATERIAL/ACTIVITY	TYPE OF INSPECTION	APPLICABLE TO THIS PROJECT			
		Y/C/P/N	EXTENT/REFERENCE	AGENT	COMPLETED
PRECAST CONCRETE					
Verify fabrication/quality control procedures	In-plant inspection of fabrication/quality control procedures**	N	IBC 1704.2		
Erection and installation	Review submittals and as-built assemblies; Field inspection of in-pace precast	N	ACI 318: Ch. 16		
MASONRY (Level: 1; Based upon Occupancy Category II)					
Materials	Review of products supplied versus certificate of compliance and material submitted	Y	Submittal & Field Review, ACI 530.1; ASCE 6; TMS602; IBC1704.5, 1708	1	
Strength	Testing/review of strength	Y	Laboratory Testing; Submittal & Field Review; ACI530.1; ASCE6; TMS 602;IBC1704.5, 2105.2.2, 2105.3	2	
Mortar and grout	Inspection of proportioning, mixing and placement.	Y	Field Review IBC 1704.5 ACI 530.1;ASCE 6; TMS 602	2	
Reinforcement, prestress, tendons, and connections	Inspect condition, size, location and spacing	N	Field Review IBC 1704.5 ACI 530.1;ASCE 5; ASCE 6; TMS 402, 602		
Protection	Inspect procedures for protection during cold and hot weather	Y	Field Review, IBC 1704.5, 2104.3, 2104.4; ACI 530.1; ASCE 6; TMS 602	2	
Anchorage	Inspection of anchorages	Y	Field Review, ACI 530.1; ASCE 5, ASCE 6, TMS 402; TMS 602; IBC 1704.5	1	
Masonry installation	Inspection of placement of masonry and joints	Y	Field Review, ACI 530.1; ASCE 6; TMS 602; IBC 1704.5	2	
STRUCTURAL STEEL					
Verify fabrication/quality control procedures	In-plant inspection of fabrication/quality control procedures**	N	IBC 1704.2		
Bolts, nuts, washers – materials	Material identification markings Review of certificate of compliance	Y	Submittal & Field Review, IBC1704.3; ASTM; AISC 360, Section A3.3	1	
Bolts, nuts, washers – installation	Inspection of in-place high-strength bolts, bearing type, and slip critical connections.	Y	Submittal & Field Review, IBC 1704.3.3, AISC 360 Section M2.5	2	
Structural steel – materials	Material identification markings and Review of Certificate of Compliance	Y	Submittal & Field Review, IBC 1704.3, 1708.4, ASTM A6, A568	1	
Structural steel details- installation	Inspection of member locations, structural details for bracing, connections, stiffening	Y	Submittal & Field Review, IBC 1704.3.2	1/2	
Weld filler materials & welder certification	Review of identification markings, certificate of compliance, and welder certifications.	Y	Submittal & Field Review, AISC 360 A3.5	1	
Welds	Inspection and testing of welds	Y	Field Review, IBC 1704.3.1, AWS, D1.1, D1.3	2	
WOOD					
Verify fabrication/quality control procedures	In-plant inspection of fabrication/quality control procedures**	N	IBC 1704.2, 1704.6		

MATERIAL/ACTIVITY	TYPE OF INSPECTION	APPLICABLE TO THIS PROJECT			
		Y/C/P/N	EXTENT/REFERENCE	AGENT	COMPLETED
WOOD (Cont'd)					
High-Load Diaphragms- Installation	Review submittal and as-built assemblies: Inspection of sheathing, framing size, nail and staple diameter and length, number of fastener lines, and fastener spacing.	N	IBC 1704.1, 1704.6.1		
SPRAYED CEMENTITIOUS AND MINERAL FIBER FIRE RESISTIVE MATERIALS					
Structural member surface conditions	Field review of surface conditions prior to application	N	AWCI 12-B; IBC 1704.10		
Application/thickness	Field review of application operations and thickness	N	AWCI 12-B; IBC 1704.10		
Mastic & Intumescent Fire Resistant Coating	Field review of application operations and thickness	N	Laboratory Testing; AWCI 12-B; IBC 1704.11		
EXTERIOR INSULATION AND FINISH SYSTEMS					
Application	Field review of application/installation	N	IBC 1704.12		
SPECIAL CASES					
Alternative Materials and Systems	As requested by Building Official, review system & installation	N	IBC 1704.13		
MAIN WIND FORCE RESISTING SYSTEM					
Wind requirements	Review of the system components and installation	N	IBC 1609.1.2, 1705.4, 1705.4.1, 1705.4.2, 1709		
SEISMIC FORCE RESISTING SYSTEMS (Based on Seismic Design Category B)					
Seismic requirements	Review of the designated seismic systems and seismic force resistance systems	N	IBC 1613, 1705.3, 1705.3.1, 1707, 1708, 1709, ASCE 7		
SMOKE CONTROL					
Special inspection of smoke control systems	Leakage testing and recording of device location, pressure difference testing, flow measurement and detection, and control verification.	N	IBC 1704.14, 1704.14.1, 1704.14.2		

INSPECTION AGENTS	FIRM	ADDRESS	TELEPHONE
1. Special Inspector:	NRW Engineering, P.C.	748 Lord Dunmore Dr. Suite 101, Virginia Beach, VA 23464	757-474-0612
2. Materials and Testing Laboratory	GET Solutions, INC	204 Grayson Road, Suite B, Virginia Beach, VA 23462	757-518-1703
3. Special Inspector Smoke Control System:			
4. (Additional Agents?)			

*The Qualifications of the Special Inspector and Testing Laboratories are subject to the approval of the Building Official (ASTM E329).
** Inspection of quality control procedures required only if fabricator is not regularly inspected by an independent inspection agency.

SECTION 024119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items identified to be reused or recycled.

B. Related Requirements:

1. Division 01 Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Division 01 Section 017300 "Execution" for cutting and patching procedures.
3. Division 31 Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Perform selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. In conjunction with selective demolition, remove the following items carefully and turn over to Owner's representative on site:

    a. Existing exit devices and lock trim at exterior doors to be demolished.
    b. Existing window treatments and mounting hardware at windows to be demolished.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: Hazardous materials may be encountered in the Work. The existing window transom to be removed contains transite in non-friable condition.

1. The Contractor shall remove the transom panels in accordance with Commonwealth of Virginia law, which requires the work to be permitted and performed by a licensed asbestos abatement subcontractor.
2. The Contractor shall prepare and submit for approval a Work Plan to remove and dispose of the transite panels. The panels total between 8 and 10 SF of surface area.
3. No other hazardous materials are expected to be encountered.
4. If other suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

5. A report on the presence of hazardous materials is on file with the York County School Division Safety Office for review and use. Examine report to become aware of locations where hazardous materials may be present.

E. Do not disturb materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

1. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. Existing roof system.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required. The Contractor shall become thoroughly familiar with the existing building and features to remain.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. All utility outages shall be coordinated in advance with the Owner. Provide not less than 14 calendar days' notice in writing of any planned utility outages. Utility outages shall be planned and implemented with minimized impact to school operations and safety.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly offsite.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075216, "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them offsite in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Burning of demolished materials will not be permitted.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them. Transport and dispose of hazardous materials and waste in accordance with all Federal, State and local laws and ordinances.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Slabs-on-grade.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Welding certificates.

E. Qualification Data: For Installer.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

G. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.

H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

I. Field quality-control test and inspection reports.

J. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 82, as drawn.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or I:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Available Products:

a. Axim Concrete Technologies; Cimfilm.
b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambco Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
k. Meadows, W. R., Inc.; Sealtight Evapre.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.

o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Available Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. Burke by Edoco; Aqua Resin Cure.
c. ChemMasters; Safe-Cure Clear.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Euclid Chemical Company (The); Kurez DR VOX.
g. Kaufman Products, Inc.; Thinfilm 420.
h. Lambert Corporation; Aqua Kure-Clear.
i. L&M Construction Chemicals, Inc.; L&M Cure R.
j. Meadows, W. R., Inc.; 1100 Clear.
k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
l. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
m. Tamms Industries, Inc.; Horncure WB 30.
n. Unitex; Hydro Cure 309.
o. US Mix Products Company; US Spec Maxcure Resin Clear.
p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Available Products:

a. Burke by Edoco; Cureseal 1315 WB.
b. ChemMasters; Polyseal WB.
c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Sealcure 1315 WB.
d. Euclid Chemical Company (The); Super Diamond Clear VOX.

e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
f. Lambert Corporation; UV Safe Seal.
g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
h. Meadows, W. R., Inc.; Vocomp-30.
i. Metalcrete Industries; Metcure 30.
j. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.
k. Tamms Industries, Inc.; LusterSeal WB 300.
l. Unitex; Hydro Seal 25.
m. US Mix Products Company; US Spec Radiance UV-25.
n. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.58.
3. Slump Limit: 4 inches, plus or minus 1 inch.

B. Concrete Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (24.13 MPa) at 28 days.
2. Minimum Cementitious Materials Content for Slabs: 520 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: For exterior exposed concrete, 6 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: Do not allow air content of interior troweled finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm)] for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
1. been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturers recommended tape.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Saw joints shall be made within 4 to 12 hours after placement of the concrete.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs, Concrete Block or Block).
2. Face brick.
3. Mortar and grout.
4. Reinforcing steel.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Cavity-wall insulation.

B. Related Sections include the following:

1. Division 07 Section 071113, "Bituminous Dampproofing" for dampproofing applied to cavity face of backup wythes of cavity walls.
2. Division 07 Section 072100, "Thermal Insulation" for rigid cavity-wall insulation.
3. Division 07 Section 076200, "Flashing and Sheet Metal" for exposed sheet metal flashing.
4. Division 07 Section 078413, "Penetration Firestopping" for firestopping at openings in masonry walls.
5. Division 07 Section 079200, "Joint Sealants" for sealing control and expansion joints in unit masonry.

C. Products installed, but not furnished, under this Section include the following:

1. Steel lintels for unit masonry, furnished under Division 05 Section "Metal Fabrications."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.

B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

C. Samples for Initial Selection: For the following:
1. Colored mortar.

D. Samples for Verification: For each type and color of the following:
1. Face brick, in the form of straps of five or more bricks.
2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Accessories embedded in masonry.

E. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

F. Qualification Data: For testing agency.

G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

    a. Include material test reports substantiating compliance with requirements.
    b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
    d. For surface-coated brick, include material test report for durability of surface appearance after 50-cycles of freezing and thawing per ASTM C 67.
    e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

I. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

J. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
      b. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
      c. Include veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
   2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
   3. Clean exposed faces of mockups with masonry cleaner as indicated.
   4. Protect accepted mockups from the elements with weather-resistant membrane.
   5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
      b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/ TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (BLOCK)

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units with 1-inch radius for all exposed, outside corners unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Weight Classification: Lightweight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.4 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units 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.

2.5 BRICK

A. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW, Type FBS, 4-inch nominal width.

1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
3. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet or shall have a history of successful use in Project's area.
4. Size (Actual Dimensions): 3-1/2 inches wide by 2-1/4 inches high by 7-1/2 inches long or 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
5. Application: Use where brick is exposed, unless otherwise indicated use the following:

a. Brick Color #1, Primary: Capitol Plant, “Richmond,” Extruded Modular with sand finish and flash range, as manufactured by Glen-Gery Brick, Manassas, Virginia.

b. Brick Color #2, Accent Band at grade (to match): Redfield Plant, "Oxford," Extruded Modular with wirecut finish, as manufactured by Glen-Gery Brick, Redfield, Iowa.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar that matches the mortar used on the existing building.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Masonry Cement: ASTM C 91.

1. Available Products:

a. Capital Materials Corporation; Flamingo Color Masonry Cement.
b. Essroc, Italcementi Group; Brixment or Velvet.
c. Holcim (US) Inc.; Mortamix Masonry Cement.
d. Lafarge North America Inc.; Magnolia Masonry Cement.
e. Lehigh Cement Company; Lehigh Masonry Cement.
f. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Cement: ASTM C 1329.

1. Available Products:

a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Colored Cement Product: Packaged blend made from masonry cement or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard "Buff" colors to match Flamingo C-320.
2. Pigments shall not exceed 10 percent of portland cement by weight.

3. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
4. Available Products:

    a. Colored Portland Cement-Lime Mix:

        1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
        2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
        3) Lafarge North America Inc.; Eaglebond.
        4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

    b. Colored Masonry Cement:

        1) Capital Materials Corporation; Flamingo Color Masonry Cement.
        2) Essroc, Italcementi Group; Brixment-in-Color.
        3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
        4) Lafarge North America Inc.; Magnolia Masonry Cement.
        5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
        6) National Cement Company, Inc.; Coosa Masonry Cement.

    c. Colored Mortar Cement:

        1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.

H. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

I. Aggregate for Grout: ASTM C 404.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

    a. Addiment Incorporated; Mortar Kick.
    b. Euclid Chemical Company (The); Accelguard 80.

c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
d. Sonneborn, Div. of ChemRex; Trimix-NCA.

K. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
4. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
5. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multi-wythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.
2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.8 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/ A 153M, Class B-2 coating.
2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from steel sheet, galvanized after fabrication not less than 0.053 inch thick. Ties made from galvanized steel sheet may be used in interior walls, unless otherwise indicated.

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
3. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls, unless otherwise indicated.

2.9 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A ; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Provide chemical or torque-controlled expansion anchors, with capability to sustain, without failure, a load equal to six times the load imposed when installed in solid or grouted unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).
2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.10 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:

    a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
    b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive.
    c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.

        1) Color: Black.

    d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
    e. Available Products:

        1) Hyload, Inc.; Hyload Cloaked Flashing System.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

2.12 CAVITY-WALL INSULATION

A. As specified under Division 07 Section 072100, "Thermal Insulation."

2.13 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

    1. Available Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270 & BIA Technical Notes 8A, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

H. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8-inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16-inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16-inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

    a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.

2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes tab-type reinforcement.
    b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
    c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with Division 07 Section "Bituminous Dampproofing."

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multi-wythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use full raked head joints to form weep holes.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.11 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding certificates.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Shop primers.
2. Nonshrink grout.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.

2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

B. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

C. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint: ASTM A 780.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Fabricate beams with rolling camber up.
2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

C. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2.6 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize shelf angles located in exterior walls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Bearing Plates: Clean masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Splice members only where indicated.

E. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds.

B. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Soffit framing.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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. AllSteel & Gypsum Products, Inc.

2. California Expanded Metal Products Company.
3. ClarkWestern Building Systems, Inc.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Mfg., Inc.
6. Custom Stud Inc.
7. Design Shapes in Steel.
8. Dietrich Metal Framing; a Worthington Industries Company.
9. Formetal Co. Inc. (The).
10. MarinoWARE.
11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
17. Steel Construction Systems.
18. Steel Network, Inc. (The).
19. Steel Structural Systems.
20. Steeler, Inc.
21. Super Stud Building Products, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    a. Upward and downward movement of 1/2 inch (13 mm).

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Lateral Design: AISI S213.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST50H (ST340H).
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90.

B. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50 (340), Class 1.
2. Coating: G60 (Z180).

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm.

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

2.9 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 60 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches (450 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cold formed and welded metal collar at RTE roof deck penetrations
2. Flat bar steel lintels over louvers.
3. Handrails and rail supports at walls.
4. Steel pipe bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Sections include the following:

1. Division 04 Section 042000, "Unit Masonry" for installing loose lintels, anchor bolts, and other items indicated to be built into unit masonry.

1.3 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: ASTM A 1003/A, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90 or equivalent.

C. Steel Sheet for Clips: ASTM A 653/A 653M, structural steel, zinc coated of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

D. Steel Tubing: Product type (manufacturing method) and as follows:

1. Cold-Formed Steel Tubing: ASTM A 500, grade as indicated below:

a. Grade A, unless otherwise indicated or required for design loading.

b. Grade B, unless otherwise indicated or required for design loading.

2. Hot-Formed Steel Tubing: ASTM A 501.

a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.

E. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.3 NONFERROUS METALS

A. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

B. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

D. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Lag Bolts: ASME B18.2.1.

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1

J. Lock Washers: Helical, spring type, ASME B18.21.1.

K. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, 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 E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb./gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb./gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3,000 psi, unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Furnish inserts if units are installed after concrete is placed.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.9 STEEL PIPE RAILINGS AND HANDRAILS

A. General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

C. Form changes in direction of railing members as follows:

1. By mitering at elbow bends.

D. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

E. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to the related structure.

G. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

H. For interior steel railings formed from steel pipe with black finish, provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves.

I. Galvanize exterior rails, fittings, brackets, fasteners, and sleeves.

2.10 PIPE BOLLARDS

1. Fabricate pipe bollards from Schedule 40 steel pipe.

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

D. Prime interior miscellaneous steel trim, where indicated with zinc-rich primer.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

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SECTION 061000 - ROUGH CARPENTRY

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. Rooftop equipment bases and support curbs.
   2. Wood blocking, cants and nailers.
   3. Miscellaneous concealed wood blocking used in stud-framed walls to provide backing support for surface-mounted features and items, such as casework, visual display boards, toilet accessories, etc.
   4. Concealed blocking and furring used in conjunction with exposed wood decking ceilings.
   5. Plywood backing panels.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   4. SPIB: The Southern Pine Inspection Bureau.
   5. WCLIB: West Coast Lumber Inspection Bureau.
   6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and 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. Use treatment that does 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 ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:
1. Concealed blocking not otherwise required to be preservative treated.
2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 Standard, Stud, grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.
9. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; No. 2 Common (Sterling); NeLMA, NLGA, WCLIB, or WWPA.
10. Mixed southern pine; No. 2 grade; SPIB.
11. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
12. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine; No. 2 grade; SPIB.

2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; No. 2 Common grade; NeLMA.
5. Northern species; No. 2 Common grade; NLGA.
6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

1. Plywood 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."

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 MISCELLANEOUS MATERIALS

A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for

fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

I. Use steel common nails or self-drilling screws unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061500 - WOOD DECKING

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. Solid-sawn wood soffit and canopy roof decking.

B. Related Sections:

1. Section 061000, "Rough Carpentry" for dimension lumber items associated with wood decking.
2. Section 099300, "Staining and Transparent Finishing" for field finishing of exposed decking.

1.3 QUALITY ASSURANCE

A. Standard for Solid-Sawn Wood Decking: Comply with AITC 112.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NLGA: National Lumber Grades Authority.
2. WCLIB: West Coast Lumber Inspection Bureau.
3. WWPA: Western Wood Products Association.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Schedule delivery of wood decking to avoid extended on-site storage and to avoid delaying the Work.

B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

PART 2 - PRODUCTS

2.1 WOOD DECKING, GENERAL

A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Moisture Content: Provide wood decking with 19 percent maximum moisture content at time of dressing.

2.2 SOLID-SAWN WOOD DECKING

A. Decking Species: Clear Fir, plainsawn.

B. Decking Nominal Size: 2x6.

C. Decking Grade: Grade 1, all select, vertical grain.

A. Grade Stamps: Factory mark each item with grade stamp of grading agency. For items of dimension lumber size, provide No. 1 select, grade lumber in accordance with grading rules of one of the following:

1. Hem-fir (north); NLGA.
2. Spruce-pine-fir; NLGA.
3. Hem-fir; WCLIB or WWPA.

B. Face Surface: Smooth.

C. Edge Pattern: Tongue and groove.

2.3 ACCESSORY MATERIALS

A. Fasteners for Solid-Sawn Decking: Provide fastener size and type complying with decking standard for thickness of deck used.

B. Screws: Steel.

2.4 FABRICATION

A. Shop Fabrication: Where preservative-treated decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.

B. Predrill decking for lateral spiking to adjacent units to comply with referenced decking standard.

C. Seal Coat: After fabricating and surfacing decking, apply a saturation coat of penetrating sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and support framing in areas to receive wood decking for compliance with installation tolerances and other conditions affecting performance of wood decking.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install solid-sawn wood decking to comply with referenced decking standard.

1. Locate end joints for combination simple and two-span continuous lay-up.

B. Apply joint sealant to seal roof decking at exterior walls at the following locations:

1. Between decking and supports located at exterior walls.
2. Between decking and exterior walls that butt against underside of decking.
3. Between tongues and grooves of decking over exterior walls and supports at exterior walls.

3.3 ADJUSTING

A. Repair damaged surfaces and finishes after completing erection. Replace damaged decking if repairs are not approved by Architect.

3.4 PROTECTION

A. Provide temporary waterproof covering as the Work progresses to protect roof decking until roofing is applied.

END OF SECTION 061500

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SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Flush overlay plastic laminate casework.
   2. Painted plywood access panels.
   3. Plastic-laminate countertops.
   4. Shelving.
   5. Shop finishing of interior woodwork.

B. Related Sections include the following:

   1. Division 06 Section 061000, "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For panel products high-pressure decorative laminate adhesive for bonding plastic laminate and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Plastic laminates.

D. Samples for Verification:

1. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm) species and cut, finished on 1 side and 1 edge.
2. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

G. Qualification Data: For fabricator.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.

C. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Plain sliced, select maple.

C. Wood Species for Opaque Finish: Poplar

D. Wood Products: Comply with the following:
   1. Hardboard: AHA A135.4.
   2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
      a. Formica Corporation.
      b. Lamin-Art, Inc.
      c. Nevamar Company, LLC; Decorative Products Div.
      d. Wilsonart International; Div. of Premark International, Inc.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Shelf Rests: BHMA A156.9, B04013; metal.

C. Cabinet Door Hinges: BHMA A156.9, BO1521-3; Semi-concealed, "full wrap" overlay hinges, self-closing, 2-1/4 inches high, matte black finish. Provide minimum two hinges per door; provide hinges at 2'-0" on center vertically for cabinet doors over nominal 3'-0" high. Provide 1/4-inch overlay at intermediate joints (where one cabinet door edge abuts another) and 1/2-inch overlay at ends of cabinets. Provide similar to Stanley Hardware No. 1592

D. Drawer Extensions: BHMA A156.9, side-mounted, full extension ball-bearing guides, two per drawer.

   1. Use B05051 for drawers over 6 inches (150 mm) deep.

   2. Use B05052 for drawers 3 to 6 inches (75 to 150 mm) deep.

   3. Use B05053 for drawers less than 3 inches (75 mm) deep.

E. Cabinet Door and Drawer Pulls: Provide face-recessed metal flush handles; satin black matte finish. Provide for screw-mounting from back (concealed) side of door/drawer front. One per door/drawer face. Provide equal to Häfele Cat. No. 151.04.328.

F. Door/Drawer Silencers: ANSI A156.16, LO3011 or LO3031; two per door or drawer. Silencers set near top and bottom of jamb.

G. Coat Hooks: Three-pronged hanger for installation at underside of cabinet top, equal to Häfele Cat. No. 846.52.808.

H. Closet Bar: ANSI A156.16, L03131 chrome finish of required length.

I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Unless stated otherwise, provide Satin Stainless Steel: BHMA 630.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Adhesive for Bonding Plastic Laminate: Contact cement.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).

D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field

measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 INTERIOR BACKSPLASHES AND COUNTER EDGE FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Wood Species and Cut: Select maple, plain sawn.

C. For trim items wider than available lumber, use veneered construction. Do not glue for width.

D. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

2.6 WARDROBE PLENUM ACCESS PANEL FOR OPAQUE FINISH

A. Grade: Economy.

B. Wood Species: MDO plywood

2.7 UNFINISHED WOOD BOOK SHELVES

A. Grade: Economy.

B. AWI Type of Cabinet Construction: As indicated

C. Wood Species and Cut for Exposed Surfaces: Birch, plain sawn or sliced.

D. Provide back of 1/4-inch (6.4-mm) tempered hardboard.

2.8 PLASTIC-LAMINATE PANELS

A. Grade: Custom. Reveal Dimension: As indicated.

B. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
1. Vertical Surfaces: Grade VGS.
2. Edges: Grade VGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Architect from laminate manufacturer's full range.

2.9 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As selected by Architect from manufacturer's full range.

C. Edge Treatment: Natural finished select white maple for natural finish.

D. Splashes: Natural finished select white maple plywood for natural finish with matching hardwood edge strips.

E. Core Material: A-C grade hardwood (Birch, Poplar or Maple) plywood made with exterior glue.

F. Adhesive for Bonding Plastic Laminate: Contact cement.

   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

G. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   1. Wood Glues: 30 g/L.
   2. Multipurpose Construction Adhesives: 70 g/L.
   3. Structural Wood Member Adhesive: 140 g/L.
   4. Architectural Sealants: 250 g/L.

2.10 FABRICATION

A. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

   1. Seal edges of openings in countertops with a coat of varnish.

2.11 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

E. Transparent Finish:

1. Grade: Custom.
2. WI Finish System 5: Catalyzed polyurethane.
3. Staining: None required.
4. Sheen: Gloss, 61-100 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

G. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

H. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

I. Paneling: Anchor paneling to supporting substrate as detailed. Do not use face fastening, unless indicated.

1. Install flush paneling with no more than 1/16 inch in 96-inch (1.5 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

J. Bookshelves: Install without distortion so shelves fit openings properly and are accurately aligned. Complete installation of hardware and accessory items as indicated.

1. Install bookshelves with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

K. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c.

L. Countertops: Anchor securely by screwing through supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Calk space between backsplash and wall with sealant specified in Division 07 Section 079200, "Joint Sealants."

M. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

N. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cold-applied, cut-back asphalt dampproofing.

B. Related Sections include the following:

1. Division 04 Section 042000, "Unit Masonry."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

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. ChemMasters Corp.
2. Degussa Building Systems; Sonneborn Brand Products.
3. Gardner Gibson, Inc.
4. Henry Company.
5. Karnak Corporation.
6. Koppers Inc.
7. Malarkey Roofing Products.
8. Meadows, W. R., Inc.
9. Tamms Industries, Inc.

B. Brush and Spray Coats: ASTM D 4479, Type I, fibered or nonfibered.

2.2 MISCELLANEOUS MATERIALS

A. Cut-Back Asphalt Primer: ASTM D 41.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
2. Test for surface moisture according to ASTM D 4263.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure six hours before applying subsequent coats.

B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.

1. Lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft.

3.5 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation (may be used in lieu of glass fiber blanket insulation).
4. Spray-applied cellulosic insulation.
5. Vapor retarder.

B. Related Sections:

1. Section 042000, "Unit Masonry" for installation of insulation in cavity walls.
2. Section 075216, "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.
3. Section 092900, "Gypsum Board" for installation in metal-framed assemblies of thermal and acoustical insulation specified by referencing this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2. Type IV, 25 psi (173 kPa); for above-grade cavity wall and other wall-embedded installation.
3. Type VI, 40 psi (276 kPa); for below-slab foundation installation.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

1. 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F (30.2 K x m/W at 24 deg C).

C. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi (276-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Pactiv Building Products.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.

B. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

C. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

D. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

E. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

F. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.

B. Reinforced-Foil-Faced, Mineral-Wool Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

2.4 SPRAY-APPLIED CELLULOSIC INSULATION

A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C 1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), chemically treated for flame-resistance, processing, and handling characteristics.

2.5 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.
b. BaySystems NorthAmerica, LLC.
c. Dow Chemical Company (The).
d. ERSystems, Inc.
e. Gaco Western Inc.
f. Henry Company.
g. NCFI; Division of Barnhardt Mfg. Co.
h. SWD Urethane Company.
i. Volatile Free, Inc.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

2.6 VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).

1. Products: Subject to compliance with requirements, provide one of the following:

a. Raven Industries Inc.; DURA-SKRIM 6WW.
b. Reef Industries, Inc.; Griffolyn T-65.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.7 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, provide one of the following:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, provide the following:

a. Gemco; 90-Degree Insulation Hangers.

2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness,

sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. AGM Industries, Inc.; RC150.
   b. Gemco; Dome-Cap R-150.

2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

   a. Ceiling plenums.
   b. Where indicated.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. AGM Industries, Inc.; TACTOO Adhesive.
   b. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

3.7 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders below concrete floor slab(s) as indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.8 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary

coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.9 INSULATION SCHEDULE

A. Masonry Cavity Wall Insulation: Type IV extruded-polystyrene board insulation.

B. Rigid Insulation behind Architectural Wall Panels: Type VI extruded-polystyrene drainage panels.

C. Perimeter Foundation Insulation: Type VI extruded-polystyrene board insulation.

D. Roof Insulation: Polyisocyanurate board insulation as specified under Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing".

E. Batt Insulation for use in thermal and acoustical applications at metal-framed walls and ceilings: Faced, glass-fiber blanket insulation.

F. Batt Insulation for use in thermal and acoustical applications at metal-framed walls and ceilings: Faced, mineral-wool blanket insulation (may be used in lieu of glass-fiber blanket insulation, and is the only insulation permitted for use in plenum-type above-ceiling applications.

G. Blown Insulation: Spray-applied cellulosic insulation, for use at the Breezeway.

H. Sprayed Insulation: Polyurethane spray foam insulation (may be used in lieu of Spray-applied cellulosic insulation at the Breezeway).

END OF SECTION 072100

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SECTION 074243 - ARCHITECTURAL WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Architectural Wall Panels for exterior wall application.
B. Moldings and support members.
C. Fasteners, adhesives and sealants, both structural and thermal/moisture.

1.2 RELATED SECTIONS

A. Division 05 Section 054000, "Cold Formed Metal Framing" for structural stud and/or Z-clip backing.
B. Division 06 Section 061000, "Rough Carpentry" for wood blocking.
C. Division 07 Section 072100, "Thermal Insulation" for insulation used in conjunction with AWPs.
D. Division 07 Section 0792 00, "Joint Sealants" for sealing joints in AWPs.

1.3 REFERENCES

A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
D. ASTM D 785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
F. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
H. ASTM 696 – Thermal Expansion

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Shop Drawings: Include elevations and detail sections of installation. Include cutting and setting drawings indicating sizes, dimensions, sections, and profiles of panels; arrangements and provisions for jointing, supporting, anchoring, and bonding panels; and details showing relationship with, attachment to, and reception of related work. Include large-scale details of each system component, anchorage, and fastening device.

D. Selection Samples: Architects selection from full range of color and texture combinations.
   1. Verification Samples: For each panel specified, two samples, minimum size 3-1/2 inches square, representing actual product, color, and patterns.

E. QUALITY ASSURANCE
   1. Manufacturer Qualifications: Provide products by a manufacturer with experience completing at least five projects of the size, scope and quality required by this project within the last five years. Provide all composite architectural panels by a single manufacturer.
   2. Installer Qualifications: Not less than three years of successful experience in completing exterior cladding systems similar in material and scope to this project.
   3. Mock-Up: Provide a mock-up for evaluation of installation techniques and finished appearance.
      a. Finish areas designated by Architect.
      b. Do not proceed with remaining work until workmanship and overall appearance are approved by Architect.
      c. Refinish mock-up area as required to produce acceptable work.
      d. Approved mock-up may be incorporated into the completed work

F. PRE-INSTALLATION MEETING
   1. For all installation systems, convene meeting to review manufacturer's recommended procedure no less than one week before panel installation is scheduled to begin. Assure attendance by representatives of Architect, Contractor, installer, and panel manufacturer's representative.

G. DELIVERY, STORAGE, AND HANDLING
   1. Deliver panels in crates on wood pallets, interwoven with protective paper and wrapped in plastic sheets.
   2. Store panels flat in original shipping crates or on wood pallets under protective cover until needed for installation. Ventilate coverings to avoid condensation. Elevate above grade on level blocking to avoid standing water.
   3. Protect panels from scuffing during handling, and apply manufacturer's recommended remedial treatment immediately if panels are soiled or

scratched. Carry panels on edge and handle carefully to avoid damage to surfaces and corner.

H. WARRANTY / CLOSEOUT
1. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
2. Comply with manufacturer's project review requirements and notification procedures to assure qualification for warranty.
3. See Section 01 78 36 - Provide manufacturer's standard 10-year warranty for non-load bearing structural integrity of panels.
4. Extra Materials:
   a. See Section 01 60 00 – Product Requirements, for additional provisions.
   b. Provide extra material as recommended by the architect and or owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer of Petrarch Architectural Panels: CEP Panels, Inc; 22 E. Chicago Avenue, Suite 210; Naperville, IL 60540. ASD. Tel: (800) 450-6099 or (630) 355-4040. Fax: (630) 355-4995. Email: mark.goetz@cep-panels.com. Website: www.cep-panels.com.

B. Manufacturer approved local distributor or local representative: (To be provided to the specifier by CEP Panels, Inc.)

C. Substitutions: Not permitted.

2.2 ARCHITECTURAL WALL PANELS

A. Petrarch Panels: 5/16 inch thick composite sheets comprising natural slate and/or stone granules or powder and/or calcium carbonate granules or powder, polyester resin, glass fiber, pigments, and fire retardant, with homogeneous color throughout.
1. Weight: 3.2 lb/sq ft.
2. Width: Varies; max. = 47-3/4 inches.
3. Length: Varies; max = 95-3/4 inches.
4. Density: 2.24, per ASTM D 792.
5. Modulus of Rupture: 5,690 psi (39.2 MPa), when tested in accordance with ASTM D 790 (ASTM D 790M).
6. Tensile Strength: 2960 psi (20.4 MPa), when tested in accordance with ASTM D 638.
7. Thermal Conductivity: 4.862 BTU-in/hr sq ft (100.9 W/m K), when tested in accordance with ASTM C 177.
8. Izod Impact: 0.49 ft-lb/in (0.009 J/m) of notch, when tested in accordance with ASTM D 256.
9. Hardness Barcol: 64, when tested in accordance with ASTM D 785.
10. Flame Spread: 15, when tested in accordance with ASTM E 84.

11. Fuel Contribution: 0, when tested in accordance with ASTM E 84.
12. Moisture Absorption: Maximum 0.2 percent by weight after 24 hours of immersion.
13. Biological Resistance: Immune to insect and vermin attack; inhibits mold growth.
14. Chemical Resistance: Impervious to most acid and organic solvents.
15. Manufacturing Tolerances:
16. Sheet size tolerance: Plus or minus 1/8 inch.
17. Thickness tolerance: Plus or minus 1/16 inch.
18. Riven textured surface: An additional plus or minus 1/16 inch.
19. Petrarch Panels Texture and Color:
    a. Color: Light Stone, 009. Shot Blast.

2.3 ACCESSORIES

A. Structural Silicone Setting System:
   1. Aluminum Bearing Plates: 80% recycled 6063-T5 alloy, 0.125 in thickness, Clear Anodized.
   2. Bearing Plate Fasteners: No. 8 x 1-1/2 inch, pan head, Stainless Steel screws.
   3. Structural Silicone: One-component structural silicone glazing sealant; provide one of the following:
      a. Dow Corning 795.
      b. GE Spilpruf.
   4. Cellular Foam Tape: Norton V2100 Series Thermal bond, P2106 Black, 3/16 inch by 1/2 inch.
   5. Adhesion Promoter: Norton Tite-R-Bond (2287).
   6. Setting Blocks: Silicone, 80-90 Shore A durometer, 1/8 inch by 11/32 inch by 4 inches.

B. Face Fastened System:
   1. Metal Framing: No. 10 or No. 6 Phillips, flat head, Tek point 410 stainless steel screws in lengths to suit application.
   2. Wood Framing: No. 10 or No. 6 Phillips, flat head, Type A point, 18/8 stainless steel sheet metal screws in lengths to suit application.
   3. Diamond Countersink Tool to suit screw size.
   4. Back Fastened System:
   5. Mounting Brackets: 1/8 in aluminum flat or angled brackets.
   6. Screws: M6 by 10 mm stainless steel hex head machine screws.
   7. Brass Inserts: Fisher PA4 M6/7.5.

C. Rain Screen System:
   1. Aluminum Extrusion Channels: 80% recycled 6063-T5 alloy. 0.125 in thickness, Black Anodized and sealed.
   2. Aluminum Extrusion Vent Screen: 0.063 in thickness, Black Epoxy Primer.

3. No. 10 Phillips, flat head, self-drilling, 410 stainless steel # 3 point, with corrosion resistant inorganic coating.
4. Weather Sealant: Silicone or polyurethane sealant and bond breaker tape as specified in Section 07 92 00.

2.4 FABRICATION

A. Provide factory fabricated panels to the extent possible, conforming to the following:
   1. Cut to custom sizes from manufacturer's standard sizes.
   2. Pre-drill and countersink fastener holes.
   3. Prepare special shapes and cutouts.
   4. Polish, bevel, or miter edges, as required.
   5. Prefabricate inside and outside corners.
   6. Prepare inserts and brackets for back fastening system.
   7. Bond insulating materials to panels.
   8. Engrave as required.

B. Perform shop or site cutting using a saw equipped with a dry cut, diamond tipped blade. If using a portable or table saw, place finished side up. If using a moveable, portable skill saw, place finished side down. Clamp to saw bed before cutting. Radius cuts can be made using an abrasive jig saw blade with carbide chips. Remove sawdust from panel surface immediately.

C. If on-site drilling or countersinking is required, drill panels with a portable hand-held pistol drill equipped with a drill guide to assure 90 degree holes and a masonry drill bit suitable for drilling at speeds of 900 to 1200 rpm. Remove any sawdust from panel surface immediately.

PART 3 - EXECUTION

3.1. GENERAL:

A. Do not begin installation until substrates have been properly prepared.
   1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2. PREPARATION

A. Measure areas of installation prior to fabrication, to minimize out of square or unbalanced border conditions.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Proceed with panel installation only when substrate is completely dry.

3.3. INSTALLATION

A. Install in strict accordance with manufacturer's instructions. Make adequate provisions for thermal and structural movement.

B. Field Assembled Face Fastened System:
   1. Locate edge fastener holes and space fasteners within limits established by panel manufacturer.
   2. Install panels with joints over bond breaker tape, and seal with silicone or polyurethane joint sealer in accordance with requirements of Section 07 90 00.
   3. Panels can be secured using a variety of exposed stainless steel fasteners or countersunk fasteners (patched with manufacturer's matching filler compound).

C. Structural Silicone Setting System:
   1. Fasten aluminum bearing plates through sheathing directly to load bearing studs.
   2. Apply continuous strips of double-faced, cellular foam tape as spacers and temporary adhesive.
   3. Apply beads of structural silicone in a one-panel area, place panel on setting blocks at base, press panel into final position, and block in place until silicone achieves full cure.
   4. Install weatherproofing joint sealer in accordance with requirements of Section 07 90 00.

D. Field Assembled Back Fastened System:
   1. Locate and space back-mounted anchors for shop installation within limits established by panel manufacturer.
   2. Fasten panel assemblies to back-up framing by means of specified screws at panel joints.
   3. Install weatherproofing joint sealer in accordance with requirements of Section 07 90 00.

E. Field Assembled Rain Screen System:
   1. Fasten aluminum H & J Channels through weather barrier sheathing directly to load bearing studs. Use vent screening at base as necessary.
   2. Install panels to Channels by means of specified screws and space fasteners within limits established by panel manufacturer, according to dead weight and wind loading.
   3. Panels can be secured using a variety of exposed stainless steel fasteners or countersunk fasteners (patched with manufacturer's matching filler compound). Stainless steel screws should have a corrosion resistant inorganic coating, like Dacroment, Magni or equivalent, to prevent galvanic corrosion between dissimilar metals.

3.4. CLEANING AND PROTECTION

A. Clean all panels of dirt, adhesive, and joint sealers, using detergents or solvents as appropriate and as recommended by the manufacturer.

B. Remove and replace any damaged panels and those that cannot be adequately cleaned.

C. Protect installed products until completion of project.

END OF SECTION 074243

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SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

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. Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing.
2. Roof insulation.

B. Section includes the installation of insulation strips in ribs of acoustical roof deck. Insulation strips are furnished under Division 05 Section "Steel Decking."

C. Related Sections:

1. Division 07 Section 072100, "Thermal Insulation" for insulation beneath the roof deck.
2. Division 07 Section 079200, "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

B. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature, the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt, within a range of plus or minus 25 deg F (14 deg C), measured at the mop cart or mechanical spreader immediately before application.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1. Corner Uplift Pressure: 80.9 lbf/sq. ft.
2. Perimeter Uplift Pressure: 53.7 lbf/sq. ft.
3. Field-of-Roof Uplift Pressure: 32 lbf/sq. ft.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance Rating: SH.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing materials, including base-ply sheet, membrane cap sheet and flashing sheet, of color specified.
2. Roof insulation.

3. Walkway pads or rolls.
4. Six insulation fasteners of each type, length, and finish.

D. Qualification Data: For qualified Installer and manufacturer.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. Maintenance Data: For roofing system to include in maintenance manuals.

H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is [UL listed] [FM Approvals approved] for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners, for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, roofing accessories, and other components of membrane roofing system.
2. Warranty Period: 20 years from date of Substantial Completion with "No-Dollar-Limit".

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SBS-MODIFIED ASPHALT-SHEET MATERIALS

A. SBS-Modified Bituminous Membrane Roofing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Firestone Building Products.
   b. GAF Materials Corporation.
   c. Johns Manville.
   d. Tremco Incorporated.

B. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers; smooth surfaced; suitable for application method specified.

C. Granule-Surface Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) granular surfaced; suitable for application method specified, and as follows:

1. Granule Color: White.

2.2 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 6164, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with polyester fabric), ASTM D 6163, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers), or ASTM D 6162, Grade S, Type I or II, SBS-modified asphalt sheet (reinforced with a combination of polyester fabric and glass fibers); smooth surfaced; suitable for application method specified.

B. Granule-Surfaced Flashing Sheet: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) granular surfaced; suitable for application method specified, and as follows:

1. Granule Color: White

C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.

2.3 AUXILIARY ROOFING MEMBRANE MATERIALS

A. Asphalt Primer: ASTM D 41.

B. Roofing Asphalt: ASTM D 312, Type IV.

C. Roofing Asphalt: ASTM D 6152, SEBS modified.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

E. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

G. Metal Flashing Sheet: As specified in Division 07 Section "Sheet Metal Flashing and Trim."

H. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve, color to match roofing membrane.

I. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.

C. Perlite Board Insulation: ASTM C 728, rigid, mineral-aggregate thermal insulation board composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.

D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/2 inch per 12 inches unless otherwise indicated.

E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Wood Blocking: Comply with requirements in Division 06 Section "Rough Carpentry".

D. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass-fiber joint tape.

2.6 WALKWAYS

A. Walkway Cap Sheet Strips: ASTM D 6163, Grade G, Type I or II, SBS-modified asphalt sheet (reinforced with glass fibers) granular surfaced; suitable for application method specified, and as follows:

1. Granule Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

a. Test for moisture by pouring 1 pint (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane.

Do not proceed with roofing work if test sample foams or can be easily and cleanly stripped after cooling.

6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
7. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.

D. Install insulation strips in ribs of acoustical roof decks according to acoustical roof deck manufacturer's written instructions.

3.3 INSULATION INSTALLATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

B. Install one lapped base-sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.

C. Wood Cant Strips: Install and secure 45-degree wood cant strips at junctures of roofing membrane system with vertical surfaces or angle changes more than 45 degrees.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of wood blocking, projections, and penetrations.

F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or more, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

H. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

3.4 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" and as follows:

1. Deck Type: I (insulated).
2. Adhering Method: M (mopped).
3. Number of SBS-Modified Asphalt Sheets: Two.
4. Surfacing Type: M (mineral-granule-surfaced cap sheet).

C. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

D. Coordinate installation of roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. At end of each day's work, provide tie-offs to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Asphalt Heating: Do not raise roofing asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed roofing asphalt manufacturer's recommended temperature limits during roofing asphalt heating. Do not heat roofing asphalt within 25 deg F (14 deg C) of flash point. Discard roofing asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.

F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.5 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

A. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Adhere to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C).
2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.
2. Apply roofing granules to cover exuded bead at laps while bead is hot.

C. Install roofing membrane sheets so side and end laps shed water.

3.6 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to roofing system manufacturer's written instructions, and as follows:

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt.
3. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C). Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

3.7 WALKWAY INSTALLATION

A. Walkway Cap Sheet Strips: Install walkway cap sheet strips over roofing membrane using same application method as used for roofing membrane cap sheet.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

B. Roofing system will be considered defective if it does not pass inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: York County School Division
2. Address: 302 Dare Road, Grafton, VA 23692
3. Building Name/Type: Seaford Elementary School.
4. Address: 1105 Seaford Road, Seaford, Virginia 23696
5. Area of Work: MER additions and equipment removals and additions on the school's existing roof.
6. Acceptance Date: <**Insert date**>.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: <**Insert date**>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding 110 mph (m/s);

c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

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.

B. Section Includes:

1. Formed Products:
   a. Formed low-slope roof sheet metal fabrications.
   b. Formed roof drainage sheet metal fabrications, including, but not limited to, scupper pans, gutters, downspouts, leader boxes and accessories.
   c. Formed wall sheet metal fabrications.

C. Related Sections:

1. Division 04 Section 042000, "Unit Masonry" for masonry-related through-wall flashings.
2. Division 06 Section 061000, "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Division 07 Section 075216, "SBS Modified Bituminous Membrane Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
4. Division 07 Section 077200, "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Manufacture and install copings and roof edge flashings tested according to ANSI/SPRI ES-1 and capable of resisting the design pressures indicated on Drawings. Provide manufactured pre-engineered roof edge systems; break-

metal assemblies fabricated in accordance with NRCA are not acceptable in lieu of manufactured pre-engineered roof edge systems specified.

1. Roof Edge Fascia System: Conform to ANSI/SPRI ES-1 Test Method RE-1 for roof edge termination to secure the membrane to a minimum of 100 psf. Conform to ANSI/SPRI ES-1 Test Method RE-2 pull-off test for fascia to meet design pressure
2. Coping System: Conform to ANSI/SPRI ES-1 Test Method RE-3 pull-off test for coping to meet design pressure requirement.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves and counter flashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

E. Qualification Data: For qualified sheet metal fabricator.

F. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge fascia and metal eave cladding; brick cap; boot umbrella; expansion joint saddles, covers, intersections, and terminations; and gutter outside corner, including supporting construction cleats, seams, attachments and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
4. In the event that mock-up fails to meet criteria, Contractor will re-build and correct the sample at no cost to the Owner until acceptable mock-up is attained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

D. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.7 PROJECT CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 , alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Surface: Smooth, flat.
2. As-Milled Finish: Standard two-side bright finish.
3. Exposed Coil-Coated Finishes:

a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
c. Color: As selected by Architect from manufacturer's full range including metallic.
d. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

1. Finish: 2D (dull, cold rolled).
2. Surface: Smooth, flat.

D. Schedule of Sheet Metal Thicknesses: See Schedule on the drawings.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Solder: For use with copper, provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.

C. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

H. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.

I. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

J. Paper Slip Sheet: 5-lb. rosin-sized building paper.

K. Polyethylene Underlayment: Minimum 6-mil carbonated polyethylene film resistant to decay when tested in accordance with ASTM E 154.

L. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

M. Roofing Cement: ASTM D 2822, asphaltic. Non-asbestos –containing.

2.3 FABRICATION, GENERAL

A. General: Shop fabricate work to greatest extent possible. Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required. All exposed corners and termination flanges in aluminum are to be fully welded.

D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

H. Do not use graphite pencils to mark metal surfaces.

2.4 SHEET ALUMINUM FASCIA SYSTEMS AND COPINGS:

A. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet, with a horizontal flange and vertical leg, fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

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. Berger Building Products, Inc.
b. Hickman Company, W. P.
c. Metal-Era, Inc.
d. Imetco Corporation.
e. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.

2. Fabricate from the following exposed metal:

a. Formed Aluminum: 0.040 inch thick.

B. Fascia for Asphalt or Modified Bitumen Roofing: Manufactured pre-engineered system consisting of minimum formed 0.040 inch aluminum fascia, extruded or formed aluminum compression clamp and minimum 24 gauge, formed, zinc-coated steel water dam; of profile and fascia height indicated; with water dam and clamp of proper configuration and size for type of roofing system indicated; with concealed splice plates. Provide prefabricated outside and inside corner, miters welded before finishing. Provide roof edge system tested in accordance with ANSI/SPRI ES-1 Test Method RE-1 for roof edge termination to secure the membrane to a minimum of 100 psf and tested in accordance with ANSI/SPRI ES-1 Test Method RE-2 pull-off test for fascia to meet design pressure requirement.

1. Nominal fascia height varies see drawings.

2. Design standard: Anchor –Tite, by Metal-Era.

C. Interlocking Multi-Part Coping System: Manufactured pre-engineered coping system (roofer-fabricated copings not acceptable) consisting of formed 0.050 inch aluminum coping of profile indicated, minimum 20 gauge zinc-coated steel anchor plates, and concealed splice plates. Provide prefabricated inside and

outside corners, miters welded before finishing; without exposed fasteners. Provide roof edge system tested in accordance with ANSI/SPRI ES-1 Test Method RE-3 pull-off test for coping to meet design pressure requirement. Design standard is Metal-Era Perma-Tite Coping-Series II.

1. Provide custom perforated metal vent component of coping system indicated. Coordinate continuous perforated vent with coping anchors at manufacturer's recommended spacing to maintain ventilation path.

2. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

   a. "Permasnap Coping"; W. P. Hickman Co.
   b. "Perma-Tite II "; Metal-Era
   c. "ES-C Sloped Coping," Imetco

D. Provide manufactured formed fascia & manufactured coping assemblies from same manufacturer with same finish.

E. Fluoropolymer Coating: Provide a high performance fluorocarbon coating conforming AAMA 2605 consisting of a minimum 70% fluoropolymer resin coating in a DFT of 0.9 mil minimum, 30% reflective gloss (ASTM D 523), over 0.15 mil minimum baked-on epoxy primer.

1. Durability: Provide coating which has been field tested under normal range of weathering conditions for minimum of 20 years without significant peel, blister, flake, chip, crack or check in finish; and without chalking in excess of 8 (ASTM D 659), and fading in excess of 5 NBS units for vertical surfaces. (Values are reduced for exposures at an angle from the vertical position.)

2. Provide colors selected by Architect from manufacturer's standards or published standard 2-coat, non-metallic colors of PPG "Duranar" or Valspar "Fluropon." One color is required for project.

3. Provide "Kynar ADS" (air cured fluoropolymer resin coating) coating material to match "Kynar 500" coating for field touch-up use.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Expansion Joint Covers, Saddles and Terminations: Fabricate to tie into expansion joint to remain. Fabricate joint plates of same thickness as covers. Furnish with continuous saddles to support edge and cover. Miter corners, weld watertight.

1. Roof Expansion Joint Profile: See drawings.
2. Joint Style: Standing seams per standard SMACNA detail.

3. Fabricate from the following materials:
   a. As shown on the Metal Flashing Schedule on the Construction Drawings.

B. Counterflashing: Fabricate from the following materials:
   a. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

C. Boot Umbrella: Fabricate from the following materials:
   a. Stainless Steel: As shown on the Metal Flashing Schedule on the Construction Drawings.

2.6 FORMED ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Gutter: Fabricate from the following materials:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

B. Gutter Supports:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

C. Downspout Straps:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

D. Downspout Leader Head:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

2.7 FORMED WALL SHEET METAL FABRICATIONS

A. Brick Cap: Fabricate from the following materials:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

B. Coping:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

C. Eave Cladding:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

D. Door Head and Jamb Flashing:
   1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

E. Window Sill Flashing:
1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

F. Channels at Architectural Wall Panels and Flat Metal Panel Siding:
1. Aluminum: As shown on the Metal Flashing Schedule on the Construction Drawings.

2.8 ALUMINUM FINISHES (TYPICAL FOR ALL EXPOSED ALUMINUM ITEMS)

A. General: Comply with AMP 501 "Finishes for Aluminum" and AMP 505 "Applied Coatings" for finish designations and application recommendations, except as otherwise indicated. For components, which are assembled or welded in factory, apply finish after fabrication is completed.

1. Provide custom colors to be selected by Architect.

2. High Performance Coating: AA-C12C42R1x (cleaned with inhibitive chemicals, conversion coated with an acid-chromate-fluoride-phosphate treatment and painted with organic coating specified below). Apply in strict compliance with coating and resin manufacturer's instructions using a licensed applicator.

a. Fluorocarbon Coating: Inhibitive thermo-cured primer, minimum 0.2 mil dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, minimum 1.0-mil dry film thickness.

B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

4. Install sealant tape where indicated.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F , set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F .
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches , except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.
2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Fascia: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated.

3.5 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with epoxy seam sealant (rivet joints for additional strength). Provide for thermal expansion. Attach gutters at eave or fascia spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.

2. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.

3. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutter.

4. Lap joints a minimum of 4 inches in direction of water flow.

C. Downspouts: As scheduled on the drawings, coated to match the color selected for the gutter.

1. Provide elbows at base of downspout to direct water away from building.

2. Provide concrete splash blocks or slabs where shown.

3. Connect downspouts to underground drainage system when indicated.

3.6 FLAT METAL PANEL (FMPs) INSTALLATION AT WALLS

A. General: Form sheet metal wall panels for a modular, sequential installation as indicated on the drawings with joints between panels oriented vertically and plumb. Shop-form all panels of metal type and thickness indicated on the drawings securing in the field. Perform as much cutting to required length in the shop to the greatest practical extent. Hem all top and bottom cut edges.

B. Joints: Vertical joints shall be loose-lock seamed, set in continuous elastomeric sealant.

C. Trim and Accessories: Apply closures and edge pieces as indicated on the drawings or otherwise required for a complete and weathertight installation. Hem and rivet all loose closure and trim pieces. Position all closure and trim pieces to ensure positive drainage of water away from seams and joints.

3.7 ALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated.

B. Through-Wall Flashing: Installation of through-wall flashing as shown on drawings

3.8 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.9 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated

and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.10 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Prefabricated Pipe Flashing
2. Prefabricated Pipe Support

B. Related Sections include the following:

1. Division 06 Section 061000, "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
2. Division 07 Section 075216, SBS-Modified Bituminous Membrane Roofing for roofing system and substrate insulation.
3. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Division 23 Section "Heating, Ventilating, and Air Conditioning" for roof-mounted HVAC equipment.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed factory-applied finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1. With Architect's approval, adjust location of roof accessories that would interrupt roof drainage routes.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. PREFABRICATED PIPE FLASHING

1. Provide products as manufactured by Thaler Metal Industries, 1-800-387-7217 (Mississauga, Ontario, Canada) or 1-800-576-1200 (New Braunfels, TX) or provide equal products by another manufacturer approved in advance by the Architect, based upon:

a. 20 year warrantee against leaks, condensation and defects in materials and manufacture, as applicable; compliance with CSA

B272-93 (Prefabricated Self-Sealing Roof Vent Flashings) air barrier design using EPDM seals only; maintenance free design; materials and sizes options, and thicknesses; treated deck flange, as applicable; written installation instructions.

b. New-Standard Sloped Roof STACK JACK Flashing Vent stack flashing: SJ-45, 12" (305 mm) high;.064" (1.6 mm) mill finish 1100-0T alloy aluminum; sized to fit pipe diameter shown; with EPDM Triple Pressure Grommet Seal and EPDM Base Seal; bituminous painted deck flange;.

B. PREFABRICATED PIPE SUPPORTS

1. Provide products as manufactured by Thaler Metal Industries, 1-800-387-7217 (Mississauga, Ontario, Canada) or 1-800-576-1200 (New Braunfels, TX) or provide equal products by another manufacturer approved in advance by the Architect, based upon:

a. Thaler Model MERS-600A, Pipe Support (single, plan pipe).
   1) Height: 22" with 4" adjustment.
   2) Description: Round hollow section of 6061-T aluminum support with threaded leg assembly for vertical adjustment and mounting plate; single stainless steel pipe roller assembly.
   3) Spacing: as shown on the Construction Drawings.

b. 20 year warranty against leaks, condensation and defects in materials and manufacture, when installed in accordance with the manufacturer's "installation instructions".

2.2 MISCELLANEOUS MATERIALS

A. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.

C. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40-mil- thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied.

D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide non-removable fastener heads to exterior exposed fasteners.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.

H. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

F. Install a 36 inch wide self-adhering modified underlayment under all mounting flanges.

G. Paint all accessories to match shingle color.

3.3 TOUCH UP

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with Division 09 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

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SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestopping systems for penetrations through fire-resistance-rated constructions, including openings containing penetrating items that are installed as part of the work of this Contract.

B. Related Sections include the following:

1. Division 07 Section 079500, "Expansion Control" for additional firestopping requirements related to building expansion joints at fire-rated wall construction.
2. Division 22 and 23 Sections specifying duct and piping penetrations.
3. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including openings containing penetrating items installed as part of this Contract, provide through-penetration firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions and fire barriers.

B. Rated Systems: Provide through-penetration firestopping systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestopping systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestopping systems with T-ratings indicated, as well as F-ratings, where

systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

a. Penetrations located outside wall cavities.
b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Where through-penetration firestopping systems are required in smoke barriers, provide through-penetration firestopping systems with L-ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 deg F (204 deg C).

C. For through-penetration firestopping systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestopping system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestopping design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestopping system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestopping condition, submit illustration, with modifications marked, approved by through-penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Through-Penetration Firestopping System Schedule: Indicate locations of each through-penetration firestopping system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestopping systems for each location identified by firestopping design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Certificates: For through-penetration firestopping system products, signed by product manufacturer.

F. Product Test Reports: From a qualified testing agency indicating through-penetration firestopping system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installation Responsibility: Assign installation of through-penetration firestopping systems to the subcontractor responsible for making the penetration.

B. Source Limitations: Obtain through-penetration firestopping systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestopping systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
   1. Through-penetration firestopping systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

      a. Through-penetration firestopping system products bear classification marking of qualified testing and inspecting agency.
      b. Through-penetration firestopping systems correspond to those indicated by reference to through-penetration firestopping system designations listed by the following:

         1) UL in its "Fire Resistance Directory."
         2) OPL in its "Directory of Listed Building Products, Materials, & Assemblies."
         3) ITS in its "Directory of Listed Products."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestopping system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestopping systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestopping systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestopping systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestopping systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestopping systems.

C. Do not cover up through-penetration firestopping system installations that will become concealed behind other construction until each installation has been examined by Owner's representative and the building inspector.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestopping systems indicated for each application that are produced by one of the following manufacturers:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestopping Products.
6. NUCO Inc.
7. RectorSeal Corporation (The).
8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestopping systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestopping systems, under conditions of service and application, as demonstrated by through-penetration firestopping system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestopping system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for firestopping systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestopping systems containing the types of fill materials indicated in the Through-Penetration Firestopping System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestopping Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
   1. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestopping systems to comply with firestopping system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestopping systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestopping systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestopping systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping system materials. Remove tape as soon as possible without disturbing firestopping system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOPPING SYSTEM INSTALLATION

A. General: Install through-penetration firestopping systems to comply with Part 1 "Performance Requirements" Article and with firestopping system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping systems.

C. Install fill materials for firestopping systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestopping systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

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. Urethane joint sealants.
2. Polysulfide joint sealants.

B. Related Sections:

1. Division 03 Section 033000, "Cast-in-Place Concrete" for sealing joints in pavements, walkways, and curbing.
2. Division 04 Section 042000, "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
3. Division 07 Section, 074243, "Architectural Wall Panels" for structural adhesion and sealing joints in exterior architectural wall panels and adjacent construction.
4. Division 07 Section 078413 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
5. Division 08 Section 084113, "Aluminum-Farmed Entrances and Storefronts" for additional instructions for sealing exterior and interior sides of aluminum framing members to adjacent construction.
6. Division 08 Section 088000, "Glazing" for glazing sealants.
7. Division 09 Section 092900, "Gypsum Board" for sealing perimeter joints.
8. Division 09 Section 093000, "Tiling" for sealing tile joints.
9. Division 09 Section 095113, "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Qualification Data: For qualified Installer.

D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

E. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

G. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. 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 or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: To match adjacent finish color.

2.2 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

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. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
    b. Tremco Incorporated; Vulkem 921.

B. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

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. Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
    b. Polymeric Systems, Inc.; PSI-901.

2.3 POLYSULFIDE JOINT SEALANTS

A. Multicomponent, Nonsag, Traffic-Grade, Polysulfide Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

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. BASF Building Systems; Sonolastic Polysulfide Sealant.
    b. Pecora Corporation; Synthacalk GC-2+.

2.4 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or

other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Architectural wall panels.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.
c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape as required to prevent contact of sealant or primer with adjoining surfaces that 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths in order to allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in

subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints in unit masonry.

b. Joints between architectural wall panels.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors windows and louvers.

2. Urethane Joint Sealant: Single component, nonsag, Class 100/50.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Control and expansion joints in tile flooring.

2. Polysulfide Joint Sealant: Multicomponent, nonsag, traffic grade.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Vertical joints on exposed surfaces of interior unit masonry walls and partitions.

2. Perimeter joints between interior wall surfaces and frames of interior doors and windows. Urethane Joint Sealant: Single component, nonsag, Class 50.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07920

SECTION 079500 - EXPANSION CONTROL

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. Interior expansion control systems.
2. Exterior wall expansion control systems.
3. Parking and open-air structure expansion control systems.

B. Related Requirements:

1. Section 076200, "Flashing and Sheet Metal" for shop- and field-fabricated roof expansion control.
2. Section 078413, "Penetration Firestopping" for fillers and joint sealants in fire-resistive building joints.
3. Section 079200 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

1.3 ACTION SUBMITTALS

A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

B. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6 inches (150 mm) long in size.

C. Samples for Initial Selection: For each type of expansion control system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

D. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches (150 mm) long in size.

E. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion control system.
2. Expansion control system location cross-referenced to Drawings.
3. Nominal joint width.
4. Movement capability.
5. Classification as thermal or seismic.
6. Materials, colors, and finishes.
7. Product options.
8. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

B. Coordination: Coordinate installation of exterior wall and soffit expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction. Materials to carry UL label and be subject to

Underwriters Laboratories follow-up service for quality assurance. Systems to be installed in strict accordance with manufacturer's installation instructions.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

2.3 INTERIOR EXPANSION CONTROL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or a comparable product by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. Construction Specialties, Inc.
4. JointMaster/InPro Corporation.
5. Michael Rizza Company, LLC.
6. MM Systems Corporation.
7. Nystrom, Inc.
8. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

D. Floor-to-Floor:

1. Basis-of-Design Product: Construction Specialties Model GFT-100.
2. Design Criteria:

a. Nominal Joint Width: 1-inch.
b. Movement Capability: -25 percent/+75 percent.
c. Type of Movement: Thermal.
d. Load Capacity:

1) Uniform Load: 150 lb/sq. ft. (732 kg/sq. m).
2) Concentrated Load: 2,000 lb (907 kg).
3) Maximum Deflection: 0.5 inch (13 mm).

e. Fire-Resistance Rating: Not applicable.

3. Type: Elastomeric seal, recessed.

a. Recessed Seal Receptor Design: As indicated on the drawings.

1) Recess Depth: 2 inches.

b. Metal: Aluminum.

1) Finish: Clear anodic, Class I.

c. Seal Material: Santoprene.

1) Color: Gray.

E. Wall-to-Wall:

1. Basis-of-Design Product: [Indicated on Drawings] <Insert manufacturer's name; product name or designation>.

a. Inside Corner, Interior Wall: Construction Specialties Model No. AFWC-100, with Model RFX-1W Fire Barrier 2-Hour (12M001010) UL# WW-D-0049.
b. Inside Corner at Interior Side of Exterior Wall: Construction Specialties Model No. ASMC-100S, with Model RFX-1W Fire Barrier 2-Hour (12M001010) UL# WW-D-0049.
c. Straight Wall-to-Wall: Construction Specialties Model No. AFW-100 with Model No. RFX-1W Fire Barrier 2-Hour (12M001010) UL# WW-D-0048.

2. Design Criteria:

a. Nominal Joint Width: 1-inch.
b. Movement Capability: -25 percent/+75 percent.
c. Type of Movement: Thermal.
d. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours.

3. Type: Cover plate or Glide plate, as specified above.

a. Cover-Plate Design: Plain.

b. Metal: Aluminum.

1) Finish: Clear anodic, Class I.

c. Metal: Stainless steel.

1) Finish: Manufacturer's standard.

d. Adjacent construction: 2 hours.

2.4 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.

1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to drain to exterior of wall expansion joint.

2.5 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304 for plates, sheet, and strips.

1. Remove tool and die marks and stretch lines or blend into finish.

C. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.

D. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.

E. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

G. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick.

H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

I. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
5. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces before installing compression seals.

E. Foam Seals: Install with adhesive recommended by manufacturer.

F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.

G. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

I. Moisture Barrier: Provide at all exterior joints and where indicated on Drawings. Provide drainage fittings at a maximum of 50 feet (15.2 m) or where indicated on Drawings.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Standard hollow metal doors and frames.

B. Related Sections:

1. Division 04 Section 042000, "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section 087100, "Door Hardware" for door hardware for hollow metal doors.
3. Division 08 Section 088000 "Glazing" for glass view panels in hollow metal doors and glass in fixed hollow metal transoms.
4. Division 09 Sections 099113 and 099123, "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Amweld Building Products, LLC.
2. Benchmark; a Division of Therma-Tru Corporation.
3. Curries Company; an Assa Abloy Group company.
4. Steelcraft; an Ingersoll-Rand company.
5. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G90 or A90 metallic coating for exterior doors and frames, and minimum G60 or A60 metallic coating for interior doors and frames.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 08 Section "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Flush panel and glazed as indicated on the Construction Drawings.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    a. Thermal-Rated (Insulated) Doors: As indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

        1) Locations: Exterior doors.

3. Vertical Edges for Single-Acting Doors: Square edge.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    d. Edge Construction: Model 2, Seamless.

e. Core: Polyisocyanurate.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches

2.5 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.6 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

5. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/NAAMM-HMMA 861.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with HMMA 840.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Sections:
1. Division 08 Section 081113, "Hollow Metal Doors and Frames" for steel door frames into which wood doors shall be installed.
2. Division 08 Section 088000, "Glazing" for glass view panels in flush wood doors.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.

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2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

    a. Provide samples for each species of veneer and solid lumber required.
    b. Provide samples for each color, texture, and pattern of plastic laminate required.
    c. Finish veneer-faced door samples with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

E. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

C. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
2. Provide WI-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
3. Provide WI-Certified Compliance Certificate for installation.

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 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. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham; an Assa Abloy Group company.
4. Haley Brothers, Inc.
5. Mohawk Flush Doors, Inc.; a Masonite company.
6. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf (3100 N).

D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. Pairs: Provide formed-steel edges and astragals with intumescent seals.
   a. Finish steel edges and astragals to match door hardware (locksets or exit devices).

E. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:

   a. 5-inch (125-mm) top-rail blocking.
   b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
   c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Species: Maple.
3. Cut: Plain sliced (flat sliced); minimum leaf width = 9 inches.
4. Match between Veneer Leaves: Pleasing match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening.

7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or more.
8. Exposed Vertical and Top Edges: Same species as faces or a compatible species.
9. Core: Either glued wood stave or structural composite lumber.
10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
11. Construction: Seven plies, either bonded or nonbonded construction.
12. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LOUVERS AND LIGHT FRAMES

A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI conversion varnish or catalyzed polyurethane system.
3. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
4. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted 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 for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

    a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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SECTION 084113 - ALUMINUM-FRAMED STOREFRONTS AND WINDOWS

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. Exterior storefront windows.
2. Storefront framing for punched opening, fixed-glass windows.

B. Related Sections:
1. Division 07 Section 079200, "Joint Sealants."
2. Division 08 Section 088000, "Glazing."

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.

g. Sealant failure.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads:
   a. Basic Wind Speed: 108 mph.
   b. Importance Factor: 1.
   c. Exposure Category: B.

2. Seismic Loads: S_s=1.5g; S_1=.05g; Soil Site Class D; an Occupancy Category II.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below them to less than 1/16 inch (1.5 mm).

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas

when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
    b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

3. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.

K. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.

L. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 38 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

2. Outdoor-Indoor Transmission Class (OITC): Minimum 38 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Delegated-Design Submittal: For aluminum-framed 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.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

G. Qualification Data: For qualified Installer.

H. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

I. Welding certificates.

J. Preconstruction Test Reports: For sealant.

K. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

L. Source quality-control reports.

M. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

N. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

O. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

G. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Commercial Architectural Products, Inc.
   2. EFCO Corporation.
   3. Kawneer North America; an Alcoa company.
   4. TRACO.
   5. Tubelite.
   6. United States Aluminum.
   7. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

   1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   3. Structural Profiles: ASTM B 308/B 308M.
   4. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads. Basis of design detailed on the drawings is Kawneer Trifab 451UT.

   1. Construction: Double-thermally broken.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Center.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.

3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using shear-block system.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform field water testing of windows.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section 088000, "Glazing."

G. Install perimeter joint sealants as specified in Division 07 Section 079200, "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).

b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

END OF SECTION 084113

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for swinging doors.
1. Provide all components including fasteners, brackets and accessories required for complete, properly functioning and operable openings.

B. Related Sections

1. Division 08 Section 081113, "Hollow Metal Doors and Frames."
2. Division 08 Section 081416, "Flush Wood Doors."
3. Division 26 Sections pertaining to electrical work related to electric locks, including, but not limited to, electrical conduit, boxes, wiring devices, low-voltage transformers and conductors.

C. References

National Fire Protection Association
NFPA 80 Standard for Fire Doors and Other Opening Protectives
Builders Hardware Manufacturers Association
ANSI/BHMA A156.1 Butts & Hinges
ANSI/BHMA A156.2 Bored and Preassembled Locks and Latches
ANSI/BHMA A156.3 Exit Devices
ANSI/BHMA A156.4 Door Controls - Closers
ANSI/BHMA A156.18 Materials and Finishes
ADA Standards for Accessible Design
Door and Hardware Institute (DHI)
Keying Systems and Nomenclature
Sequence and Format
Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
Recommended Locations for Architectural Hardware for Flush Wood Doors.

1.2 SUBSTITUTIONS:

A. Comply with Division 1

1.3 SUBMITTALS:

A. Comply with Division 1

B. Product Data: Submit 6 copies which include technical data indicating design, grade, function and relevant accessories of each hardware item indicated in

the hardware sets. Highlight in some manner only information relative to the scheduled products. Provide wiring riser and point to point diagrams for all openings scheduled with electrified hardware. Indicate all electrical requirements including amps and voltages for each electrified item.

C. Shop Drawings: Submit 6 copies of a detailed Hardware Schedule in a vertical format as outlined in the DHI publication "Sequence and Format." Include the following:

1. Door numbers corresponding to Architects door numbers as indicated on the architectural drawings.
2. Manufacturers List of each hardware product group scheduled
3. Abbreviations List

D. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable timely door and frame preps.

E. Samples: Furnish as requested by the Architect.

F. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit the following in a three ring binder:

a. "As Built" Hardware Schedule.
b. Catalog Cuts.
c. Installation instructions for each hardware item.
d. Warranties.
e. Approved Keying Schedule.
f. Point to point and Riser diagrams for each opening scheduled with electrified hardware.

QUALITY ASSURANCE

G. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

a. Distributor to employ a full time Architectural Hardware Consultant for the purpose of scheduling and coordinating hardware, establishing a keying schedule and be available for consultation at reasonable times throughout the project until final completion..

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

    a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
    c. Provide and install hardware for fire rated openings in conformance with NFPA 80.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".

B. Storage and Protection: Store hardware in a clean, dry, secure area.

1.5 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.6 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Ten years
2. Exit Devices: Three Years
3. Exit Devices Electrified: One Year
4. Locksets: Three years

1.7 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.8 MAINTENANCE:

A. Extra Materials: provide owner with any manufacture's product installation tools and remaining fasteners at project completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers and manufacturer's product model numbers indicated in the Hardware Sets are listed below with an asterisk. Acceptable manufacturers are listed without an asterisk.

Item:	Manufacturer:	Acceptable:
Hinges	*Stanley	Hager, Ives
Locksets	*Best	Sargent, Schlage
Exit Devices	*Precision	Von Duprin, Sargent
Closers	*Stanley	Corbin, Sargent
Push / Pulls	*Rockwood	Trimco, Hager
Protective Plates	*Rockwood	Trimco, Hager
Stops	*Rockwood	Trimco, Hager
OH Stops	*ABH	Rockwood, Glynn Johnson
Flush Bolts	*Rockwood	Trimco, Hager
Wall Stops	*Rockwood	Trimco, Hager
Weatherstrip	*National Guard	Pemko, Reese
Thresholds	*National Guard	Pemko, Reese
Smoke Seal	*National Guard	Pemko, Reese

2.2 MATERIALS:

A. Hinges:

1. Certified to ANSI/BHMA A156.1.
2. Provide hinges for fire rated doors conforming to NFPA 80
3. Furnish heavy weight hinges at high frequency or high abuse locations and as indicted in the hardware sets
4. Provide hinge types as listed in schedule.
5. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
6. Furnish NRP (Non Removable Pin) on hinges at all reverse bevel exterior doors and as indicated in the hardware sets.

B. Cylindrical Locks and Latches:

1. Best 93K Series 15D lever trim.
   Certified to ANSI/BHMA A156.2 Series 4000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2, UL10C-1998 listed.
2. Functions and design as indicated in the hardware groups
3. Provide strike box at each lock location.
5. Provide strike of sufficient lip length to clear wall and frame trim..

C. Exit Devices:

1. Certified to ANSI/BHMA A156.3 Grade 1.
2. Non-fire rated and electric exit devices shall have cylinder dogging.
3. Provide power supplies for electric latch retraction by same manufacturer as exit devices.
4. Provide power supplies with sufficient amps to operate latch retraction.
5. Touchpad shall be "T" style.
6. Fire exit device shall bear a label indicating it is "Fire Exit Hardware."
7. Exposed components shall be of architectural metals and finishes.
8. Provide strikes as required by application.
9. Fire exit devices to be listed for UL10C.
10. UL listed for Accident Hazard.

D. Cylinders:
1. Owner to provide Best cores.

E. Door Closers:

1. Certified to ANSI/BHMA A156.4 Grade 1.
2. Conform to ADAAG for opening and closing requirements.
3. Separate adjusting valves for closing and latching speed, and backcheck.
4. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.
5. Furnish with adjustable spring power.
6. Mount closers on non-public side of door, unless otherwise noted in specification.
7. Closers shall be non-handed, non-sized and multi-sized 1 through 6.
8. Provide drop plate brackets as required at aluminum and glass doors.
9. All exterior closers to have hold open and stop arm feature.

F. Protection Plates: Furnish with four beveled edges, by door width less 2 (two) inches on single doors and 1 inch less door width on pairs of doors, unless indicated otherwise in hardware sets. Furnish oval-head countersunk screws to match finish. Mop Plates to be 4 (four) inches in height and kickplates to be 10 (ten) inches in height.

G. Thresholds: Type required by conditions. Furnish with ¼-20 machine screws and expansion shields.

H. Weatherstripping: at head and jambs.

I. Flush Bolts: Provide extended rods as required by door height to engage in strike to properly secure door. Provide manufacturers dust proof strikes.

L. OH Stops: Furnish at all doors where wall stops or closer stop arms are not feasible.

M. Wall Stops: Provide proper fasteners applicable for wall conditions.

2.3 FINISHES:

A. Provide finishes as scheduled. Use manufacturer's standard finishes conforming to ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products. Match finishes as closely as possible between products. General Finishes scheduled: 626 Satin Chromium, 630 Satin Stainless Steel, 689 Sprayed Aluminum Closers, 628 Aluminum or Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames

2. Recommended Locations for Hardware For Architectural Flush Wood Doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Install conforming to ADAAG for mounting heights, operational closer requirements, and other ADA requirements.

C. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. After installation is complete, inspect completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Report findings, in writing, to the Architect that all hardware is installed properly and provides complete, properly functioning, operating openings. Indicate corrective actions and recommendations if necessary for compliance.

3.5 SCHEDULE OF FINISH HARDWARE:

Set #1
Doors 116, 117, 118

2	Cont Hinge	651	630	ST
1	Rim Exit	2101	626	PR
1	Rim Exit	2108 x 4908A	626	PR
1	Cylinder	1E72	626	BE
2	Closer	D-4550	689	ST
2	Kickplate	8" x 2" LDW	630	RO
2	W/strip	303AS		PE
2	Sweep	315CN		PE
2	T/hold	171A		PE

Electric strike and DPS by Access Control Supplier

Set #2
Door 103

2	Cont Hinge	651	630	ST
1	Rim Exit	FL2101	626	PR
1	Rim Exit	FL2108 x 4908A	626	PR
1	Cylinder	1E72	626	BE
2	Closer	D-4550	689	ST
2	Kickplate	8" x 2" LDW	630	RO
2	W/strip	303AS		PE
2	Sweep	315CN		PE
2	T/hold	171A		PE

Electric strike and DPS by Access Control Supplier

Set #3
Door 101

6	Hinge	FBB168 4 ½" x 4 ½"	626	ST
2	Rim Exit	FL2115	626	PR
2	Closer	D-4550	689	ST
2	Kickplate	8" x 2" LDW	630	RO
2	Gasket	S88D		PE

Magnetic Hold Open by Access Control supplier.

Set #4
Door 102

3	Hinge	FBB168 4 ½" x 4 ½"	626	ST
1	Rim Exit	FL2115	626	PR
1	Closer	D-4550	689	ST
1	Kickplate	8" x 2" LDW	630	RO
1	Gasket	S88D		PE

Magnetic Hold Open by Access Control supplier.

Set #5
Doors 104, 106, 107, 109, 110, 111, 112, 113

3	Hinge	FBB168 4 ½" x 4 ½"	626	ST
1	Lock	93K-7IN-15D-S3	626	BE
1	Closer	D-4550	689	ST
1	Kickplate	8" x 2" LDW	630	RO
1	Gasket	S88D		PE
1	Stop	409	630	RO

Set #6
Door 105

3	Hinge	FBB168 4 ½" x 4 ½"	626	ST
1	Privacy	93K-0L-15D-S3	626	BE
1	Deadbolt	B571	626	SC
1	Closer	D-4550	689	ST
1	Kickplate	8" x 2" LDW	630	RO
1	Gasket	S88D		PE

1	Stop	409	630	RO

Set #7
Door 108

3	Hinge	FBB168 4 ½" x 4 ½"	626	ST
1	Privacy	93K-0L-15D-S3	626	BE
1	Stop	409	630	RO
3	Silencer	608		RO

Set #8
Doors 114, 115

3	Hinge	FBB168 4 ½" x 4 ½"	626	ST
1	Lock	93K-7D-15D-S3	626	BE
1	Closer	D-4550	689	ST
1	Kickplate	8" x 2" LDW	630	RO
1	Gasket	S88D		PE
1	Stop	409	630	RO

END OF SECTION 087100

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SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Aluminum storefront and punched opening window framing.
   2. Wood and hollow metal door glazing.
   3. Fixed hollow metal transom glazing.

B. Related Sections:
   1. Division 08 Section 081113, "Hollow Metal Doors and Frames."
   2. Division 08 Section 081416, "Flush Wood Doors."
   3. Division 08 Section 084113, "Aluminum Framed Storefronts and Windows."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 & ICC's 2009 International Building Code by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Basic Wind Speed: 108 mph.
      b. Importance Factor: 1
      c. Exposure Category: B.
   2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
   4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
   5. Glass Type Factors for Wired, Patterned, and Sandblasted Glass:
      a. Short-Duration Glass Type Factor for Wired Glass: 0.5.
      b. Long-Duration Glass Type Factor for Wired Glass: 0.3.
      c. Short-Duration Glass Type Factor for Patterned Glass: 1.0.
      d. Long-Duration Glass Type Factor for Patterned Glass: 0.6.
      e. Short-Duration Glass Type Factor for Sandblasted Glass: 0.5.
   6. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
   1. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.

F. Product Certificates: For glass and glazing products, from manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass and insulating glass.

H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

D. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

E. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or [the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
3. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

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. AFG Industries, Inc.; Krystal Klear.
b. Guardian Industries Corp.; Ultrawhite.
c. Pilkington North America; Optiwhite.
d. PPG Industries, Inc.; Starphire.

B. Heat-Treated Float Glass, including Tempered: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

C. Polished Wired Glass: ASTM C 1036, Type II, Class 1 (clear), Form 1, Quality-Q6, complying with ANSI Z97.1, Class C.

1. Mesh: M2 (square).

D. Figured/Patterned Glass (for use at toilets): ASTM C 1036, Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F1 (patterned one side), Privacy Level 5. Provide a uniform, fine etched/sandblasted finish.

1. Acceptable products include Pilkington "OptiFloat," "Opal." Products of other manufacturers may be considered subject to submittal to and approval by the Architect.

2.3 INSULATING GLASS

A. Manufacturers: Provide material produced by an approve Manufacturer, subject to compliance with the specified requirements,

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Manufacturer's standard Dual seal.
2. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.7 INSULATING-GLASS TYPES

A. Glass Type GL-1: Tempered insulating glass, for use in transoms and at Breezeway (under Alternate #2).

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Clear tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Clear tempered float glass.

B. Glass Type GL-2: Heat-Strengthened insulating glass, for use in windows of Classrooms, Resource Rooms, Teacher's Room, and Corridor Light Monitors.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Clear float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Clear float glass.
6. Low-E Coating: Pyrolytic or sputtered on second or third surface.

C. Glass Type GL-3: Heat-Strengthened insulating glass, for use in restroom windows

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Clear float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Figured/Obscure glass, with figured/obscure side on third surface.
6. Low-E Coating: Pyrolytic or sputtered on second surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Related Sections include the following:
1. Division 09 Section 092900, "Gypsum Board" for wall finish over non-load bearing wall and soffit framing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: the manufacturer's standard rust-inhibiting coating or hot-dip galvanized, unless otherwise indicated.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
2. Depth: As indicated on Drawings.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).

C. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm)
2. 7/8 inch (22.2 mm).

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

   1. Space studs as follows:

      a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

D. Direct Furring:

   1. Screw to substrate as shown on the drawings.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

B. Related Sections include the following:
1. Division 09 Section 092216, "Non-Structural Metal Framing."
2. Division 07 Section 072100, "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
3. Division 09 Section 099123, "Interior Painting" for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

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. American Gypsum Co.
b. G-P Gypsum.
c. National Gypsum Company.
d. USG Corporation.

B. Regular Type:

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1. Core: 5/8 inch (15.9 mm), Type X
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.
b. L-Bead: L-shaped; exposed long flange receives joint compound.
c. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type: Vertical surfaces, unless otherwise indicated.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints [at locations indicated on Drawings] [according to ASTM C 840 and in specific locations approved by Architect for visual effect].

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. L-Bead: Use 200B

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated and as shown on the construction drawings.

3.6 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

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. Ceramic tile.
2. Metal edge strips.

B. Related Sections:
1. Section 079200, "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Module Size: Actual tile size plus joint width indicated.

C. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum>0.60 wet and >0.65 dry.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory.
3. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, signed by product manufacturer.

D. Material Test Reports: For each tile-setting and -grouting product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each color or finish from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Joint sealants.
   2. Metal edge strips.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

   1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.5, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Tile Type: Glazed paver tile.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      a. American Marazzi Tile, Inc.
      b. American Olean; Division of Dal-Tile International Inc.
      c. Crossville, Inc.
      d. Daltile; Division of Dal-Tile International Inc.
      e. Florida Tile Industries, Inc.

   2. Composition: Porcelain.
   3. Face Size: 11-13/16 by 11-13/16 inches (300 by 300 mm).
   4. Thickness: 5/16"
   5. Face: Plain with square or cushion edges.
   6. Finish: Semimat, clear glaze.
   7. Tile Color and Pattern: As shown on the Construction Drawings.
   8. Grout Color: As selected by Architect from manufacturer's full range.
   9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

      a. Base Cove: Cove, module size same as adjoining flat tile.
      b. External Corners for Thin-Set Mortar Installations: Surface bullnose, module size same as adjoining flat tile.
      c. Internal Corners: Cove, module size .

2.3 SETTING MATERIALS

A. Dry-Set Portland Cement Mortar (Thin Set): ANSI A118.1.

   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. Bonsal American; an Oldcastle company.

b. Laticrete International, Inc.
c. MAPEI Corporation.
d. Summitville Tiles, Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

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. Bonsal American; an Oldcastle company.
   b. Laticrete International, Inc.
   c. MAPEI Corporation.
   d. Summitville Tiles, Inc.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

2.4 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

1. Basis-of-Design Product: 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. Bonsal American; an Oldcastle company.
   b. Laticrete International, Inc.
   c. MAPEI Corporation.
   d. Summitville Tiles, Inc.

2.5 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."
1. Sealants 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."
2. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

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. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
b. Dow Corning Corporation; Dow Corning 786.
c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
f. Tremco Incorporated; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

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. Bonsal American; an Oldcastle company; Grout Sealer.
b. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
c. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with bonded mortar bed] comply with surface finish requirements in ANSI A108.5 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Paver Tile: 3/16-inch.
   2. Ceramic tile: 1/16-inch minimum, 3/32-inch max.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

   1. Remove latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.5 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F113: Thin-set mortar; TCA F113.

    a. Tile Type: Glazed Porcelain
    b. Thin-Set Mortar: Latex-portland cement mortar.
    c. Grout: Standard sanded cement grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical panel ceilings installed with exposed suspension systems.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 26 Section 265100, "Interior Building Lighting" for lighting fixtures in acoustical ceilings.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of product specified.

2. Samples for verification purposes of each type of exposed finish required, prepared on samples of size indicated below and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

a. 6-inch-square samples of each acoustical panel type, pattern, and color.

b. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.

3. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineers and Owners, and other information specified.

4. Product test reports from qualified independent testing laboratory that

are based on its testing of current products for compliance of acoustical ceiling systems and components with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

B. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling unit from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

C. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and operable partition system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.6 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Mineral Base Panels - Water Felted, with Painted Finish and Perforated and Fissured Pattern, Non-Fire-Resistance Rated:

a. "Minaboard Cortega," Armstrong World Industries, Inc.
b. "Hytone Baroque," Celotex Corp.
c. "Auratone Natural Fissured II," USG Interiors, Inc.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Non-Fire-Resistance-Rated Single-Web Steel Suspension Systems:

a. Chicago Metallic Corporation.
b. Armstrong World Industries, Inc.
c. National Rolling Mills, Inc.
d. USG Interiors, Inc.

2. Edge Moldings:

a. Armstrong World Industries, Inc.
b. Chicago Metallic Corporation.
c. National Rolling Mills, Inc.
d. USG Interiors, Inc.

2.2 ACOUSTICAL CEILING UNITS, GENERAL

A. Standard for Acoustical Ceiling Units: Provide manufacturers' standard units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches 400 mm away from the test surface) per ASTM E 795.

B. Colors and Patterns: Provide products to match appearance characteristics indicated under each product type.

1. For acoustical ceiling units whose appearance characteristics are indicated by reference to ASTM E 1264 designations for pattern and not by limiting to the naming of one or more products or manufacturers, provide Engineer's selections from each named manufacturer's full range of standard products of type, color, pattern, and light reflectance indicated.

2.3 MINERAL-BASE ACOUSTICAL PANELS - NODULAR, CAST, OR MOLDED APC

A. Type, Form, and Finish: Provide Type III, Form 1 units per ASTM E 1264 with painted finish that comply with pattern and other requirements indicated.

B. Fissured Pattern: Units fitting ASTM E 1264 pattern designation D, with other characteristics as follows:

1. Color/Light Reflectance Coefficient: White/LR 0.75.
2. Noise Reduction Coefficient: NRC 0.65.
3. Ceiling Sound Transmission Class: CSTC 35.
4. Edge Detail: Square.
5. Size: As shown on the drawings.
6. Pattern: Non-directional fissured.

2.4 TRANSLUCENT CEILING PANELS IN CORRIDORS BENEATH LIGHT MONITORS

A. Type, Form, and Finish: "Infusions" by Armstrong Ceiling products, no substitutions allowed. Manufactured from polycarbonate sheet with infused pattern.

B. Color and Pattern: "Clear Arbor" (TCA), 2 feet by 2 feet panel dimensions for use in lay-in ceiling grid.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Standard for Metal Suspension Systems: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

1. Gage: Provide wire 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 0.106-inch diameter (12 gage).

D. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit type of edge detail and suspension system indicated.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

3. For acoustical tile adhered to substrate, provide edge moldings at ceiling perimeters and where indicated.

4. For ceiling pockets, provide manufacturer's standard one- or two-piece recess, formed from bent sheet steel, factory pre-finished. Acceptable products as detailed on the drawings include perimeter brake-formed pockets, manufactured by one of the following:

a. Gordon Interior Specialties Division
b. The Wenig Company, Inc.

2.6 NON-FIRE-RESISTANCE-RATED DIRECT-HUNG SUSPENSION SYSTEMS

A. Wide-Face Single-Web Steel Suspension System: Main and cross-runners roll-formed from prepainted or electrolytic zinc-coated cold-rolled steel sheet, with prepainted 15/16-inch-wide flanges; other characteristics as follows:

1. Structural Classification: Intermediate-Duty System.

2. Finish: Painted, white.

2.7 MISCELLANEOUS MATERIALS

A. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division 7 Section "Joint Sealers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical ceiling systems to comply with installation standard referenced below, per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

1. Standard for Installation of Ceiling Suspension Systems: Comply with ASTM C 636.

2. Standards for Installation of Ceiling Suspension Systems: Comply with ASTM C 636 and ASTM E 580.

B. Arrange acoustical units and orient directionally patterned units in a manner shown by reflected ceiling plans.

C. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail due to age, corrosion, or elevated

temperatures.

4. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.

5. Do not attach hangers to steel deck tabs.

6. Do not attach hangers to steel roof deck. Attach hangers to structural members.

7. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

D. Install edge moldings of type indicated at perimeter of acoustical ceiling area and 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 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

E. 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.

1. 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.

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 that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Sections:
1. Division 09 Section 096520, "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F .

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

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. Armstrong World Industries, Inc.
b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
c. Flexco, Inc.
d. Johnsonite.
e. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe) for resilient flooring and Straight (flat or toeless) for carpeted areas.

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

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. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
b. Flexco, Inc.
c. Johnsonite.
d. Roppe Corporation, USA.

B. Description: Carpet edge for glue-down applications, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet Transition strips.

C. Material: Vinyl.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate. Leveling amounts in the contract are those needed to properly install products listed. There will be no increase to the contract for additional leveling agents.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096520 - RESILIENT TILE FLOORING

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. Vinyl composition floor tile.

B. Related Sections:

1. Division 09 Section 096513, "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. Test Data: Submit concrete surface dryness test results as specified herein.

E. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Concrete Surface Dryness Testing: Prior to installing resilient tile flooring, perform at least two (2) in-field moisture tests upon the concrete slabs in the building, remotely-located from one another, in accordance with one of the following test methods:

1. ASTM F 1869 (2011), Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

2. ASTM F 2170 (2011), Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

Tests shall be performed by a qualified testing agency, and report of findings shall be submitted in writing to the Owner. If concrete test results indicate that concrete slab has not cured sufficiently to meet the resilient tile flooring manufacturer's requirements for substrate dryness, Contractor shall implement dehumidification and other measures as necessary to accelerate and dry out the building, including the concrete slabs. Do not install resilient tile flooring until concrete floor slabs test in compliance with the resilient tile flooring manufacturer's requirements.

B. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

C. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

D. Close spaces to traffic during floor tile installation.

E. Close spaces to traffic for 48 hours after floor tile installation.

F. Install floor tile after other finishing operations, including painting, have been completed.

1.7 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements,:

1. Armstrong World Industries, Inc.; Imperial Texture Standard Excelon
2. Congoleum Corporation ; Alternatives

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch.

E. Size: 12 by 12 inches .

F. Colors and Patterns: As selected by Architect from full range of industry colors and patterns.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate. Leveling amounts in the contract are those needed to properly install products listed. There will be no increase to the contract for additional leveling agents.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square in patterns indicated on the drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Except where indicated otherwise on the drawings, lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION 096520

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. PVC downspouts.
   2. Steel canopy framing members.
   3. Hollow metal doors and frames.
   4. Brick lintels.

B. Related Sections include the following:
   1. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Product List: For each product indicated, include the following:

   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use; in tightly covered containers; in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 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. Benjamin Moore & Co.
2. Bennette Paint Mfg. Co., Inc.
3. Duron, Inc.
4. PPG Architectural Finishes, Inc.
5. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMER SEALERS
A. Alkali-Resistant Primer: MPI #3.
B. Bonding Primer (Solvent Based): MPI #69.

2.4 METAL PRIMERS
A. Cementitious Galvanized-Metal Primer: MPI #26.

2.5 EXTERIOR ALKYD PAINTS
A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).
B. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of paint materials with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site,

pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.

a. Prime Coat: Cementitious galvanized-metal primer (unless factory primed).
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semi-gloss).

B. Plastic Trim Fabrication Substrates:

1. Alkyd System: MPI EXT 6.8B.

a. Prime Coat: Bonding primer (solvent based).
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (flat).

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete masonry units (CMU).
2. Steel doors and steel frames.
3. Gypsum wall board.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming and finishing carpentry specified in this Section.
3. Division 09 Section 099113, "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F .

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 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. Benjamin Moore & Co.
2. Bennette Paint Mfg. Co., Inc.

3. Duron, Inc.
4. ICI Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range <Insert requirements>.

2.3 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

2.4 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.5 METAL PRIMERS

A. Quick-Drying Alkyd Metal Primer: MPI #76.

B. Cementitious Galvanized-Metal Primer: MPI #26.

2.6 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

2.7 ALKYD PAINTS

A. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).

B. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements.

Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. Alkyd over Latex Sealer System: **MPI INT 4.2N.**

    a. Prime Coat: Interior/exterior latex block filler (unless previously painted).
    b. Sealer Coat: Interior latex primer/sealer.
    c. Intermediate Coat: Interior alkyd matching topcoat.
    d. Topcoat: Interior alkyd (semigloss).

B. Steel Substrates:

1. Alkyd System: **MPI INT 5.1E.**

    a. Prime Coat: Alkyd anticorrosive metal primer (unless materials is supplied with a factory applied primer).
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd (semigloss).

C. Galvanized-Metal Substrates:

1. Alkyd System: **MPI INT 5.3C.**

a. Prime Coat: Cementitious galvanized-metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (flat).

D. Gypsum Board Substrates:

1. Alkyd over Latex Primer System: **MPI INT 9.2C.**

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semigloss).

END OF SECTION 099123

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SECTION 099300 - STAINING AND TRANSPARENT FINISHING

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 surface preparation and application of wood finishes on the following substrates:

1. Exterior Substrates:
   a. Dressed lumber (finish carpentry) – exposed decking at exterior canopy soffit.

B. Related Requirements:

1. Section 061500, "Wood Decking" for wood products used at exterior canopy soffit.
2. Section 099113, "Exterior Painting" for standard paint systems on exterior substrates.
3. Section 099600, "High-Performance Coatings" for transparent high-performance coatings on concrete masonry surfaces.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.

1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) long.
2. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
   2. Bennette Paint Mfg. Co., Inc.
   3. Columbia Paint & Coatings.
   4. Davis Paint Company.
   5. Diamond Vogel Paints.
   6. Duron, Inc.
   7. ICI Paints.
   8. M.A.B. Paints.
   9. PPG Architectural Finishes, Inc.
   10. Pratt & Lambert.
   11. Sherwin-Williams Company (The).
   12. Zinsser.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

   1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
   2. Shellacs, Clear: VOC not more than 730 g/L.
   3. Stains: VOC not more than 250 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Low-Emitting Materials: Interior stains and finishes 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. Stain Colors: Clear, i.e., not stained, finish is required.

2.3 WOOD FILLERS

A. Wood Filler Paste: **MPI #91.**

2.4 PRIMERS AND SEALERS

A. Primer, Latex for Exterior Wood: **MPI #6.**

B. Primer, Alkyd for Exterior Wood: **MPI #5.**

C. Primer, Oil for Exterior Wood: **MPI #7.**

D. Preservative, for Exterior Wood: **MPI #37.**

E. Alkyd, Sanding Sealer, Clear: **MPI #102.**

F. Shellac: **MPI #88.**

2.5 STAINS

A. Stain, Exterior, Water Based, Solid Hide: **MPI #16.**

B. Stain, Exterior, Solvent Based, Solid Hide: **MPI #14.**

C. Stain, Exterior, Solvent Based, Semi-Transparent: **MPI #13.**

D. Stain, for Exterior Wood Decks: **MPI #33.**

E. Stain, Semi-Transparent, for Interior Wood: **MPI #90.**

2.6 WATER-BASED VARNISHES

A. Varnish, Water Based, Clear, Satin (Gloss Level 4): **MPI #128.**

B. Varnish, Water Based, Clear, Semi-Gloss (Gloss Level 5): **MPI #129.**

C. Varnish, Water Based, Clear, Gloss (Gloss Level 6): **MPI #130.**

2.7 SOLVENT-BASED VARNISHES

A. Varnish, with UV Inhibitor, Exterior, Semi-Gloss (Gloss Level 5): **MPI #30.**

B. Varnish, with UV Inhibitor, Exterior, Gloss (Gloss Level 6): **MPI #29.**

C. Varnish, Marine Spar, Exterior, Gloss (Gloss Level 7): **MPI #28.**

D. Varnish, Interior, Flat (Gloss Level 1): **MPI #73.**

E. Varnish, Interior, Semi-Gloss (Gloss Level 5): **MPI #74.**

F. Varnish, Interior, Gloss (Gloss Level 6): **MPI #75.**

2.8 POLYURETHANE VARNISHES

A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): **MPI #57.**

B. Varnish, Interior, Polyurethane, Oil-Modified, Gloss (Gloss Level 6): **MPI #56.**

C. Varnish, Polyurethane, Moisture-Cured, Gloss (Gloss Level 6): **MPI #31.**

D. Varnish, Aliphatic Polyurethane, Two-Component (Gloss Level 6 or 7): **MPI #78.**

2.9 OIL FINISH

A. Danish Oil: **MPI #92.**

2.10 SOURCE QUALITY CONTROL

A. Testing of Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are

incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.

    a. For solid hide stained wood, stain edges and ends after priming.
    b. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood decking.

1. Clear, Two-Component Polyurethane Varnish System:

a. Prime Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
b. Intermediate Coat: Varnish, aliphatic polyurethane, two-component, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7**, MPI #78**.

END OF SECTION 099300

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Interior Substrates:

a. Concrete masonry units (CMU/Block).

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 painting Sections for special-use coatings and general field painting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of finish-coat product indicated.

C. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F .

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F .

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Colors: As selected by Architect from manufacturer's full range.

2.2 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI#4.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Benjamin Moore & Co.; Moorcraft, Super Craft Latex Block Filler, 285-01.
b. PPG Architectural Finishes, Inc.; Speedhide, Int/Ext Block Filler, 6-15.
c. Sherwin-Williams Company (The); PrepRite, Int/Ext Block Filler, B25W25.

B. Epoxy Block Filler: MPI #116.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Block Filler, 97-685.
b. Sherwin-Williams Company (The); Industrial & Marine, Kem Cati-Coat HS Epoxy Filler/Sealer, B24W400/V400 S.

2.3 EPOXY COATINGS

A. Epoxy, Cold-Cured, Semi-Gloss:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Benjamin Moore & Co.; Polyamide Epoxy Coating, M36/M37.
b. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Cold Cured Gloss, 95-1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Masonry (Clay and CMU): 12 percent.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce coating systems indicated.

D. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Epoxy Coating System:

a. Prime Coat: Interior/exterior latex block filler, MPI #4.
b. Intermediate Coat: Epoxy, cold-cured, gloss, MPI #77.
c. Topcoat: Epoxy, cold-cured, gloss, MPI #77.

END OF SECTION 099600

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SECTION 101100 - VISUAL DISPLAY SURFACES

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. Markerboards.
   2. Tackboards.
   3. Display Rail.
   4. Unitized assemblies including two or three of the above items.

1.3 DEFINITIONS

A. Markerboard: Framed or unframed, porcelain-enameled surface used for writing with dry-erase markers, with integral display rail and marker trough (chalktray). Markerboard surface shall also have a specular, glare reducing finish suitable for display of electronically-projected visual images.

B. Display Board: Framed or unframed, tackable, visual display board assembly.

C. Display Rail: Continuous extruded assembly with tackable surface insert.

D. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.

E. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
   1. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:

   1. Actual sections of markerboard and tackboard assemblies.
   2. Include accessory Samples to verify color selected.

D. Samples for Verification: For each type of visual display surface indicated.

   1. Visual Display Surface: Not less than 8-1/2 by 11 inches (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   2. Trim: 6-inch- (152-mm-) long sections of each trim profile.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more

pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings 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.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.10 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated, complying with ASTM A 424 or ASTM A 463/A 463M, Type 1.

1. Manufacturers/Products: Subject to compliance with requirements, provide products indicated by one of the following:

a. Claridge Products and Equipment, Inc.; Vitracite Markerboard
b. PolyVision Corporation; a Steelcase company; P^3 ceramicsteel Chalkboard.

2. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.

3. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.

B. Melamine: Thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

C. High-Pressure Plastic Laminate: NEMA LD 3.

D. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout.

E. Hardboard: ANSI A135.4, tempered.

F. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.

G. Fiberboard: ASTM C 208.

H. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

I. Adhesives: Low- or No-Volatile Organic Compound (VOC) content only.

2.2 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick,]porcelain-enamel face sheet with low-gloss finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Claridge Products and Equipment, Inc.
    b. PolyVision Corporation; a Steelcase company.

2. Hardboard Core: 1/4 inch (6 mm) thick; with 0.015-inch- (0.38-mm-) thick, aluminum sheet or 0.013-inch- (0.35-mm-) thick, galvanized-steel sheet backing.
3. Particleboard Core: 1/2 inch (13 mm) thick; with 0.015-inch- (0.38-mm-) thick, aluminum sheet or 0.013-inch- (0.35-mm-) thick, galvanized-steel sheet backing.
4. Fiberboard Core: 3/8 inch (9.5 mm); with 0.015-inch- (0.38-mm-) thick, aluminum sheet or 0.013-inch- (0.35-mm-) thick, galvanized-steel sheet backing.

5. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
6. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 DISPLAY BOARD (TACKBOARD) 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. AARCO Products, Inc.
2. Best-Rite Manufacturing.
3. Claridge Products and Equipment, Inc.
4. Marsh Industries, Inc.; Visual Products Group.
5. PolyVision Corporation; a Steelcase company.

B. Plastic-Impregnated Cork Tackboard: 1/4-inch- (6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard or particleboard backing.

2.4 MODULAR SUPPORT SYSTEM FOR VISUAL DISPLAY BOARDS

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. AARCO Products, Inc.
2. Best-Rite Manufacturing.
3. Claridge Products and Equipment, Inc.
4. Platinum Visual Systems; a division of ABC School Equipment, Inc.
5. PolyVision Corporation; a Steelcase company.

B. Standards: 72-inch- (1829-mm-) long, extruded-aluminum slotted standards designed for supporting visual display boards on panel clips. Standards shall be punched at not less than 4 inches (100 mm) o.c.

1. Finish: Clear anodic.

C. Panel Clips: Extruded aluminum or steel with finish to match standards.

2.5 VISUAL DISPLAY RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AARCO Products, Inc.
2. Best-Rite Manufacturing.
3. Claridge Products and Equipment, Inc.
4. Platinum Visual Systems; a division of ABC School Equipment, Inc.
5. PolyVision Corporation; a Steelcase company.

B. General: Manufacturer's standard, aluminum-framed, tackable, plastic-impregnated cork visual display surface fabricated into narrow rail shape and designed for displaying material.

2.6 RAIL SUPPORT SYSTEM FOR VISUAL DISPLAY BOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Best-Rite Manufacturing.
2. Egan Visual Inc.
3. KOH Design, Inc.
4. Peter Pepper Products, Inc.
5. PolyVision Corporation; a Steelcase company.

B. Support Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards; capable of gripping and suspending paper directly from rail.

1. Finish: Clear anodic.

C. Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display boards by engaging support rail and top trim of board.

D. Visual Display Panels: Fabricated from not less than 3/8-inch- (9.5-mm-) thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage, and with aluminum trim designed to engage hanger clips.

2.7 MARKERBOARD AND TACKBOARD ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.

1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
2. Factory-Applied Trim: Manufacturer's standard.

B. Marker tray: Manufacturer's standard, continuous.

1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

C. Map Rail: Provide the following accessories:

1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches (25 to 50 mm) wide.
2. End Stops: Located at each end of map rail.
3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches (1219 mm) of display rail or fraction thereof.
4. Flag Holder: One for each room.
5. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

2.8 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, [balanced around center of board, as acceptable to Architect.

D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.11 VISUAL DISPLAY SURFACE SCHEDULE

A. Markerboards and Tackboards, Factory assembled.

1. Markerboard Surface: Porcelain enamel markerboard for use with dry erase markers, low-sheen/low-glare surface suitable for video projection.
2. Tack Surface: Natural-cork tackboard assembly.
3. Corners: Square.
4. Width: As indicated on Drawings.
5. Height: As indicated on Drawings.
6. Mounting: Wall.
7. Mounting Height: As indicated on Drawings.
8. Edges: Concealed by trim.

a. Factory Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

1. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
2. Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.

a. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
b. Painted Surfaces: Treat areas susceptible to pigment bleeding.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.

1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches (610 mm) o.c.

3.4 INSTALLATION OF VISUAL DISPLAY WALL PANELS

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.5 INSTALLATION OF FIELD-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Field-Assembled Visual Display Units: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
2. Provide manufacturer's standard vertical-joint H-trim system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

3.6 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.

1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches (610 mm) o.c.

a. Attach marker trays to boards with fasteners at not more than 12 inches (300 mm) o.c.

3.7 INSTALLATION OF VISUAL DISPLAY RAILS

A. Display Rails: Install rails in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches (400 mm) o.c.

1. Mounting Height: As indicated on the drawings.

END OF SECTION 101100

SECTION 102113 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes stock, manufactured toilet compartments.

B. Types of toilet compartments include:
1. Solid plastic, homogenous color.

C. Styles of toilet compartments include:

1. Floor- and wall-anchored, overhead-braced.

D. Related Sections:

1. Division 10 Section 102800, "Toilet Accessories" for accessories, such as toilet paper holders, grab bars, and other items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for materials, fabrication, and installation including catalog cuts of anchors, hardware, fastenings, and accessories.

C. Shop drawings for fabrication and erection of toilet compartment assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.

D. Samples of full range of colors for each type of unit required. Submit 6-inch-square samples of each color and finish on same substrate to be used in work, for color verification after selections have been made.

1.4 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop

drawings and fabrication, where possible, to ensure proper fitting of work. However, allow for adjustments where taking of field measurements before fabrication might delay work.

B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet compartments and related items. Coordinate delivery with other work to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Solid Plastic - Polymer Resin:

a. Capitol Partitions, Inc.
b. Sanatec Industries, Inc.
c. Santana Products Co.
d. Sanymetal Products Corp.

2.2 MATERIALS

A. General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

B. Solid Plastic: High density, solid polymer resin with homogenous color throughout. Provide material not less than 1 inch thick with seamless construction with edges eased. Color as selected by Architect from submitted range of manufacturer's standard color offerings.

C. Concealed Anchorage Reinforcement: Minimum 0.108 inch (12 gage), galvanized steel sheet.

D. Concealed Tapping Reinforcement: Minimum 0.0785 inch (14 gage), galvanized steel sheet.

E. Pilaster Shoes and Caps: ASTM A 167, Type 302/304 stainless steel, not less than 3 inches high, 0.0396 inch thick (20 gage), finished to match hardware.

F. Stirrup Brackets: Manufacturer's standard design for attaching panels to walls and pilasters, either stainless steel or anodized aluminum.

G. Hardware and Accessories: Manufacturer's standard design, heavy duty operating hardware and accessories of anodized aluminum or stainless steel. Zamac is not permitted.

H. Overhead Bracing: Continuous extruded aluminum, antigrip profile, with clear anodized finish.

I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass, finished to match hardware, with theft-resistant-type heads and nuts. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective-coated steel.

2.3 FABRICATION

A. General: Furnish standard doors, panels, screens, and pilasters fabricated for compartment system. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.

B. Door Dimensions: Unless otherwise indicated, furnish 24-inch-wide in-swinging doors for ordinary toilet stalls and 36-inch-wide (clear opening) out-swinging doors for stalls equipped for use by handicapped.

C. Overhead-Braced Compartments: Furnish galvanized steel supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous, extruded, aluminum, anti-grip, overhead bracing at top of each pilaster. Provide shoe at each pilaster to conceal supports and leveling mechanism.

D. Floor-Supported Components: Furnish galvanized steel anchorage devices complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters to permit structural connection at floor. Provide shoe at each pilaster to conceal anchorage.

E. Wall-Hung Screens: Furnish panel units in sizes indicated, of same construction and finish as partition system panels.

F. Hardware: Furnish hardware for each compartment to comply with ANSI A117.1 for handicapped accessibility and as follows:

1. Hinges: Cutout inset type, adjustable to hold door open at any angle up to 90 degrees. Provide gravity type, spring-action cam type, or concealed torsion rod type to suit manufacturer's standards.

2. Latch and Keeper: Recessed latch unit, designed for emergency access, with combination rubber-faced door strike and keeper.

3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for handicapped accessibility, with combination rubber-faced door strike and keeper.

4. Coat Hook: Manufacturer's standard unit, combination hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.

5. Door Pull: Manufacturer's standard unit for out-swinging doors. Provide pulls on both faces of handicapped compartment doors.

2.4 FINISH

A. Color: One of manufacturer's standard colors in each room, as indicated or, if not indicated, as selected by Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's recommended procedures and installation sequence. Install compartment units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch between pilasters and panels, and not more than 1 inch between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Locate wall brackets so that holes for wall anchorages occur in masonry or tile joints. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.

B. Overhead-Braced Compartments: Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Supported Compartments: Set pilaster units with anchorages having not less than 2 inches penetration into structural floor, unless otherwise recommended by partition manufacturer. Level, plumb, and tighten installation with devices furnished. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.

D. Screens: Attach with anchoring devices as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.

3.2 ADJUST AND CLEAN

A. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors (and entrance swing doors) to return to fully closed position.

B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION 102113

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SECTION 102800 - 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 SUMMARY

A. This Section includes toilet accessory items as scheduled on the drawings.

B. Division 10 Section 102113 "Toilet Compartments" for toilet compartments, partitions, screens and related accessories.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.

B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.

C. Samples of each toilet accessory item to verify design, operation, and finish requirements. Acceptable full-size samples will be returned and may be used in the Work.

D. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

E. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.

F. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Owner.

1.5 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 15 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:

1. A & J Washroom Accessories.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. General Accessory Manufacturing Co.
6. McKinney/Parker.

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness.

B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16; Castings, ASTM B

30.

C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 527, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

F. Baked Enamel Finish: Factory-applied, gloss white, baked acrylic enamel coating.

G. Mirror Glass: Nominal 6.0-mm (0.23-inch) thick, conforming to ASTM C 1036, Type I, Class 1, Quality q2, and with silvering, electro-plated copper coating, and protective organic coating.

H. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 TOILET TISSUE DISPENSERS

A. This item to be furnished by the Owner and installed by the Contractor.

1. Mounting: Surface mounted on wall or toilet partition, concealed anchorage.

2.4 GRAB BARS

A. Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05 inch (18 gage) and as follows:

1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
2. Clearance: 1-1/2-inch clearance between wall surface and inside face of bar.
3. Gripping Surfaces: Manufacturer's standard nonslip texture.
4. Heavy-Duty Size: Outside diameter of 1-1/2 inches.

B. Provide Bobrick series B-6160 in the sizes and shapes shown on the drawings, or equal as approved by the Owner.

2.5 SOAP DISPENSERS

A. Liquid Soap Dispenser, Wall-Mounted: This item to be furnished by the Owner and installed by the Contractor.

2.6 MIRROR UNITS

A. Standard Stainless Steel Framed Mirror Units: Fabricate frame with channel shapes not less than 0.04 inch (20 gage), with square corners carefully mitered to hairline joints and mechanically interlocked. Provide in Type 430 bright polished finish. Provide in sizes as scheduled on the drawings. Provide for concealed mounting of all mirrors.

2.7 WARM-AIR DRYERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product as follows, no substitutions allowed:

1. World Dryer Corporation, "SMARTdri" (standard unit).

C. Warm-Air Dryer :

1. Mounting: Surface mounted.

2. Operation: Automatic electronic/infrared sensor activated with timed power cut-off switch.

a. Operation Time: When activated, unit run for a minimum of three (3) seconds and shall cut-off when hands are removed from under unit. Unit shall automatically cut off and reset after 30 seconds.

3. Cover Material and Finish: Stainless steel, No. 4 finish (satin).

4. Electrical Requirements: Unit shall be U.L.-listed. Coordinate with circuit requirements indicated on the electrical drawings. Specified unit is available in one of three configurations:

a. 115V, 10.5A, 1,200W max.
b. 208-240V, 5.2A, 1,250W max.
c. 220-240V, 5.0A, 1,200w max.

2.8 FABRICATION

A. General: Only a maximum 1-1/2-inch-diameter, unobtrusive stamped

manufacturer logo, as approved by Owner, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.

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.

C. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

1. Provide galvanized-steel backing sheet, not less than 0.034 inch (22 gage) and full mirror size, with non-absorptive filler material. Corrugated cardboard is not an acceptable filler material.

D. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theft proof installation.

E. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

C. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.2 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 strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

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. Fire protection cabinets for the following:

a. Portable fire extinguishers.

B. Related Sections include the following:

1. Division 04 Section 042000, "Unit Masonry" for masonry wall construction, including fire-resistive wall construction, into which semi-recessed fire extinguisher cabinets will be mounted.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function.

E. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 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.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

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. J. L. Industries, Inc., a division of Activar Construction Products Group; "Cosmopolitan".
b. Larsen's Manufacturing Company; "Architectural Series".

B. Cabinet Construction: Rated.

C. Cabinet Material: Stainless-steel sheet.

D. Semi-recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim

face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.

1. Rolled-Edge Trim: 2 1/2-inch backbend depth.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:
1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Vertical.

K. Finishes:
1. Stainless Steel: No. 4.

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

1. General: Install fire protection cabinets in locations and at mounting heights indicated.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 122413 - ROLLER WINDOW SHADES

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. Manually operated roller shades with double rollers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches (250 mm). Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.

3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 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. Roller Shades: Full-size units equal to 10 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than six units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:

1. Draper Inc.
2. Hunter Douglas Contract.
3. MechoShade Systems, Inc.
4. Nysan Solar Control Inc.; Hunter Douglas Company.
5. OEM Shades Inc.
6. Shade Techniques, LLC.
7. Silent Gliss USA, Inc.
8. SM Automatic, Inc.

C. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Spring Operating Mechanisms: Roller contains spring sized to accommodate shade size indicated. Provide with positive locking mechanism that can stop shade movement at each half-turn of roller and with manufacturer's standard pull.

1. Pole: Manufacturer's standard type in length required to make operation convenient from floor level and with hook for engaging pull.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Reverse, from front of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube, permitting replacement of the shade fabric.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Shadebands:

1. Shadeband Material: Light-blocking fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Exposed with endcaps.
b. Color and Finish: As specified below in section entitled "Shadeband Materials."

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches (76 mm).

2. Endcap Covers: To cover exposed endcaps.

3. Installation Accessories Color and Finish: Satin chrome or stainless steel. Provide manufacturer's standard mounting clips and fascia support. Units to be secured to lintels above windows. Provide for concealed or flushed/countersunk mounting of all items to the greatest practical extent.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: PVC-coated polyester.
3. Weave: Mesh.
4. Thickness: 0.037-inch.
5. Weight: 20.7 oz./sq. yd. (g/sq. m)>.
6. Roll Width: To suit centerline-of-mullion to centerline-of-mullion dimensions of windows at jambs.
7. Orientation on Shadeband: Up the bolt.
8. Openness Factor: 3 percent.
9. Color: Hunter Douglas Contract, SheerWeave 4400, Color: "Eco-Granite."

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

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SECTION 123661 – SOLID SURFACE MATERIAL WINDOW SILLS

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. Solid-surface-material window sills.

B. Related Sections:

1. Section 042000, "Unit Masonry" for construction of walls upon which window sill materials will be mounted.

2. Section 079200, "Joint Sealants" for sealing joints between sill members and joints between sill members and adjacent window frame and wall construction.

1.3 ACTION SUBMITTALS

A. Product Data: For window sills.

B. Shop Drawings: For window sills. Show materials, finishes, exposed edge profile, methods of joining, and method of sealing to adjacent construction.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:

1. Window sill material, 6 inches (150 mm) square.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of window sills by field measurements after windows openings and window frames are installed.

B. Prior to installation, inspect masonry sill conditions at window openings to verify that each is acceptably level, clean and free of excess mortar, and is otherwise ready to receive solid surface window sills. Inspect alignment of window frame sill member with respect to wall below and verify that frame member's length is parallel to wall below and will permit square and true installation of the solid surface window sill. Bring unacceptable conditions immediately to the attention of the Contractor. Contractor shall correct all substrate deficiencies prior to proceeding with installation of solid surface window sills.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL WINDOW SILLS

A. Configuration: Provide window sills with continuous, eased edges at length of exposed side. Radius of eased edge shall not exceed 1/8-inch.

B. Window Sills: 1/2-inch- (12.7-mm-) thick, solid surface material.

C. Fabrication: Fabricate window sills in one piece for widths of window masonry openings up to nominal 10'-8". Where width of window masonry opening exceeds this dimension at the Resource Room area, provide window sill in two pieces, with intermediate joint concealed by intersecting wall that divides the two Resource Rooms.

1. Fabricate loose backsplashes for field installation.

2.2 WINDOW SILL MATERIALS

A. Adhesives: Adhesives shall be low- or no-VOC and shall not contain urea formaldehyde.

B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

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. Avonite Surfaces.
b. E. I. du Pont de Nemours and Company.
c. Formica Corporation.
d. LG Chemical, Ltd.
e. Meganite Inc.
f. Samsung Chemical USA, Inc.

g. Swan Corporation (The).
h. Transolid, Inc.
i. Wilsonart International.

2. Type: Provide Standard Type unless Special Purpose Type is indicated.

3. Colors and Patterns: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install window sills level to a tolerance of 1/8 inch in 10 feet (3 mm in 2.4 m).

B. Secure solid-surface window sills to masonry substrate in full bed of non-staining urethane building polyurethane construction adhesive as follows:

1. Liquid Nails, "Marble & Granite and Solid Surface Materials Adhesive," Low-VOC (LN-933).

C. Clean and protect windows prior to final acceptance. Clean with products and methods recommended by solid surface material manufacturer.

END OF SECTION 123661

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SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

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. Roll-up rail mats.
2. Recessed frames.

1.3 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.
4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Sections of floor mat for color selection/confirmation.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m).
2. Wheel load of 350 lb (159 kg) per wheel.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.2 ROLL-UP RAIL MATS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, no substitutions allowed:

1. American Floor Products Company, Inc., "Heritage Grate" roll-up mat

B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 1-1/2 inches (38 mm) wide by 3/4 inch (19 mm) thick, sitting on continuous vinyl cushions.

1. Tread Inserts: Ribbed-design-surface, resilient vinyl/Santoprene.
2. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of manufacturer's available colors.
3. Rail Color: Clear anodized aluminum.
4. Hinges: Plastic/Vinyl
5. Mat Size: As indicated on the drawings. Contractor to field verify exact frame and mat dimensions.

2.3 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52. Extruded member to be 1-3/8 inches deep by 1/2-inch wide and allow for providing 3/4-inch recess for mat.

a. Color: Clear anodized aluminum.

2. Architectural Bronze: ASTM B 455, Alloy UNS No. C38500.

2.4 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.5 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and post-installed expansion anchors.

C. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths.

2. Edge frame to have integral or nut-and-bolt anchors set to the extrusion that permit permanent, secure anchorage in surrounding concrete.

D. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, specified recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. For installation in terrazzo flooring areas, provide allowance for grinding and polishing of terrazzo without grinding surface of recessed frames. Coordinate with other trades as required.
2. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
3. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

B. Install surface-type units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 22050 - PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 230100, "Mechanical General Provisions," apply to this Section.

1.2 SERVICE CONNECTIONS

A. Contractor shall make connections of building waste and storm sewer to existing piping as indicated on drawings.

B. Connections to existing rain and overflow rain leaders shall be made where indicated to convey rainwater to grade.

C. Domestic water serving the new additions hall be accomplished by connecting to piping within the existing building.

1.3 PERMITS

A. Contractor shall give all required notices and secure all necessary permits. Inspection certificates from local authorities having jurisdiction shall be delivered to the Architect prior to final payment.

1.4 GENERAL REQUIREMENTS

A. Follow Plumbing Code and fuel gas code for minimum requirements; where drawings or specifications are at variance with Code, follow whichever provides for maximum size or condition.

B. Verify all grades, elevations, and utility connections before commencing work.

C. Make arrangements with local gas company for replacement of existing gas meter if required.

D. Comply with requirements of the Uniform Federal Accessibility Standards (UFAS).

E. All pipe, fittings, and fixtures that are connected to potable water systems must meet the 1996 Safe Water Drinking Act, and where applicable, meet NSF Standard 61, and be so labeled and be so certified.

1.5 SUBMITTALS AND SHOP DRAWINGS

A. Submit manufacturers' data on the following:
Plumbing Fixtures
Plumbing Fixture Supports

Faucets
Flush Valves
Balancing Valves
Supplies and Traps
Trap Primers
Floor Drains
Cleanouts
Water Hammer Arresters
Valves
Backflow Preventers
Wall Hydrants
Electric Water Heaters
Recirculating Pumps
Grease Interceptor
Thermometers
Mixing Valves
ADA Pipe Covers
Thermal Expansion Tanks
Gas Regulator

B. Submit shop drawings on the following:

Grease Traps

C. Submit a schedule of all pipe materials to be used for each type of service.

1.6 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of materials and workmanship for a period of 12 months from date of Substantial Completion.

B. During the guarantee period, the Contractor shall repair or replace defective material and workmanship and place same in working order to the satisfaction of the Architect at no additional expense to the Owner.

C. Contractor shall service the systems for 12 months from date of Substantial Completion. Such service shall include all emergency services and adjustments, except cleaning of filters and screens.

PART 2 - PRODUCTS

2.1 SOIL, WASTE, DRAIN, AND VENT PIPING

A. Underground soil, waste, drain and vent piping within the building and to the point of connection to existing piping outside of building foundation shall be centrifugally cast, coated Service Weight hub-and-spigot (ASTM A74), hubless cast-iron (ASTM A888), or DWV Schedule 40 PVC pipe (ASTM D2665) and fittings, unless otherwise noted.

B. Above ground soil, waste, drain and vent piping shall be hubless cast-iron pipe (ASTM A888), or DWV Schedule 40 PVC pipe (ASTM D2665) and fittings, except that PVC pipe shall not be used where piping penetrates fire partitions or any location not allowed by the Building Code. PVC piping for any service shall not be installed in return air plenums. Use materials acceptable to be used in return air plenums.

C. Foam Core PVC piping is not acceptable for any application.

D. Hub-and-spigot piping shall be assembled using plain-end spigot and positive double-seal elastomeric compression-type gasket joints above ground. Hubless pipe and fittings shall be assembled using Neoprene gasket and stainless-steel retaining sleeve. Underground hubless pipe and fittings shall be assembled per paragraph below. PVC pipe and fittings shall be assembled in strict accordance with manufacturer's instructions. Solvent cement shall conform to ASTM D2564.

E. Hubless Cast-iron Pipe and Fittings - Below Grade: Joints shall be heavy duty, Factory Mutual approved, to FM 1680 Class 1, type 304 stainless-steel couplings with a shield thickness of .024 (24 gauge) with 125 in/lb. worm drive clamps with Neoprene gaskets conforming to ASTM C564. Couplings 1-1/2" to 4" in diameter shall be 3" wide and have two clamps. Couplings 5" to 10" in diameter shall be 4" wide and have four clamps. Couplings 12" and 15" wide shall be 5-5/8" wide and have six clamps. Model HI-TORQ 125 as manufactured by CLAMP-ALL PRODUCTS, or approved equal.

2.2 CLEANING PLUGS AND TEST TEES

A. Provide cleanouts as indicated and/or required by the Plumbing Code.

B. Cleanouts shall be the same size as pipe, up to 4". Cleanouts for pipes larger than 4" shall be sized in accordance with the Plumbing Code. Cleanouts installed in connection with cast-iron, hub-and-spigot pipe shall consist of longsweep 1/4 bends or one or two 1/8 bends extended to easily accessible, approved location or where indicated. Extra-heavy cast-brass ferrule with cast-brass cleanout plug shall be caulked into hub of fittings and shall be flush with floor. Cleanouts in connection with threaded pipe shall be cast-iron drainage T-pattern 90-degree branch fittings with extra-heavy brass screw plugs of the same size as pipes, up to and including 4". Install test tees with cast-iron cleanout plugs at foot of soil, waste and drain stacks, and on each building drain outside building. Where cleanouts occur on pipe concealed in partitions and walls, provide with chromium-plated cast-brass plate

secured to brass plugs. Verify cleanout locations before pipe installation. Extend cleanout plugs to within 1" of finished wall.

C. See paragraph FIXTURES AND EQUIPMENT for cleanout access covers.

D. Cleanouts indicated outside of building shall be flush with grade and have concrete pad as specified in Section 230100.

2.3 TRAPS

A. Provide a trap for each fixture and piece of equipment requiring connections to drainage system. Supply traps with fixtures. Place each trap as near fixture as possible, and no fixture shall be double trapped. Traps installed on threaded pipe shall be recess drainage pattern. Trap on all floor drains shall be deep-seal type.

B. Provide trap primers on floor drains as indicated on plans. Trap primers by PRECISION, or approved equal.

C. Exposed traps and drain piping shall be chromium plated.

2.4 WATER PIPING

A. Water piping shall be copper tubing, Type K, hard-tempered underground, and Type L, hard-tempered above ground. Piping shall be assembled with wrought-copper fittings using 95-5 solder above ground and silver solder underground.

B. Provide factory-fabricated water hammer arresters on hot and cold water supplies to fixtures as indicated and/or required to prevent water hammer. Water hammer arresters shall be sized in accordance with Plumbing and Drainage Institute WH201. JOSAM, ZURN, or SMITH may be used.

2.5 GAS PIPING

A. Gas piping above ground ½" through 2" shall be Schedule 40 black steel screw fabricated using malleable-iron fittings and piping 2-1/2" and over shall be fabricated by welding using Schedule 40 steel welding fittings. Gas piping and fittings exposed to the weather shall be Schedule 40 galvanized steel.

2.6 UNDERGROUND GAS PIPING

A. Gas piping underground shall be MDPE polyethylene gas pipe as manufactured by PERFORMANCE PIPE, J.M. EAGLE, or approved equal.

B. Interchangeability of Pipe and Fittings: The same manufacturer shall supply polyethylene pipe and heat fusion fittings. Pipe and fittings from different manufacturers shall not be interchanged.

C. Polyethylene Pipe: Pipe shall be DRISCOPLEX™ 6500 PE 2406 polyethylene pipe, or approved equal, and shall be manufactured and tested in accordance with the latest published edition of ASTM D2513.

D. Polyethylene Fittings: Polyethylene heat fusion fittings shall be manufactured and tested by the pipe manufacturer in accordance with ASTM D2513 and D.O.T. requirements.

E. Heat Fusion Joining: Butt, socket, and saddle fusion joints in polyethylene gas piping shall be made using procedures that have been qualified and approved by the operator in accordance with Title 49, CFR, Part 192.283.

F. In accordance with CFR, Part 192.285, the operator shall ensure that all persons making heat fusion joints have been qualified to make joints in accordance with the operator's Approved Qualified Fusion Procedures. The operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. The Contractor shall ensure that all persons making heat fusion joints are qualified in accordance with this Section.

G. The manufacturer shall offer qualified fusion procedures and training materials for the use of the operator.

H. Butt Fusion of Unlike Wall Thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR, for example, SDR 9 to SDR 11, or SDR 11 to SDR 13.5. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple (a short length of the heavier wall pipe with one end machined to the lighter wall) or by mechanical means or electrofusion. Standard DRs for polyethylene pipe are 7.3, 9, 11, 13.5, 17, and 21.

I. Joining by Other Means: Polyethylene gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by the operator for use in his gas distribution system. When joining by other means, the installation instructions for the joining device manufacturer shall be observed.

J. When mechanical OD compression couplings are used, polyethylene gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.

K. Provide factory fabricated transition fittings where joining to steel piping.

2.7 VALVES

A. Provide valves on piping as indicated and as required to isolate fixtures and equipment and to give complete control of water in risers and branch lines. Valves shall be ball, unless otherwise indicated.

B. No cast-iron valves shall be used on domestic hot water piping. Valves shall be bronze or brass body valves only.

C. Valves on copper water piping, up to and including 2", shall be bronze or brass. . Valves on cold water piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. Catalog numbers indicated are

NIBCO. Valves with equivalent characteristics by MILWAUKEE, APOLLO VALVE, or CRANE CO. will be acceptable.

Type	Size	Catalog Number
Ball	2" and smaller	S585-80-LF
Check	2" and smaller	S413-Y-LF

D. Flush Valves: SLOAN numbers indicated; or equal by ZURN, DELANY acceptable.

E. Reduced Pressure Principle Backflow Preventers: (No Lead)

Size	Catalog Number
2" and smaller	975 XLS2 w/strainer

Provide air gap fitting. WILKINS catalog models indicated, or approved equal.

F. All gas valves 3" and smaller shall be bronze body, threaded with bronze trim ball valves. Gas valves hall be UL-Listed. Valves shall be as manufactured by NIBCO model T-585-70-UL, or approved equal.

2.8 VENTURI FLOW MEASURING AND BALANCING VALVES

A. Provide venturi flow measuring and balancing valves where indicated, NuTech Model MB for pipe size 1/2" to 2" or approved equal.

B. Balancing valves ½" thru 2" shall be constructed of bronze or brass. Valves shall be rated for 600 psi at 250°F. The valve ball ID shall be minimum standard port (one size smaller than valve connection size) Reduced port valves are not acceptable.

C. Venturi section shall be low loss with a minimum accuracy of 3% of rate.

D. Valves shall be provided with pressure/temperature ports and memory stop. Valves shall be equipped with metal tag and chain. Valves shall be supplied with extended handles and PT ports to clear insulation on chilled water service.

E. Valves shall be sized as indicated or as recommended by valve manufacturer for intended flow capacity.

2.9 FIXTURES AND EQUIPMENT

A. Provide complete fixtures and equipment indicated on drawings. Catalog numbers are KOHLER, unless otherwise indicated. Provide supply stops for all fixtures. AMERICAN STANDARD or ELJER fixtures may be used, and TOTO where specifically indicated.

B. Provide concealed, floor-mounted, fixture support carriers for all wall-mounted plumbing fixtures, including: urinals, lavatories, and water coolers. Provide floor-mounted supports with concealed arms for wall-hung lavatories. Carriers shall be as manufactured by ZURN, or approved equal. Contractor to select proper model to suit wall construction.

C. All water coolers and drinking fountains are to be lead-free.

D. Provide Owner with any special tools required to perform maintenance on fixtures and fittings.

E. Wall hydrants shall be freezeless type, Model 65 satin-chrome finish, with loose key handle, vacuum breaker, and backflow preventer. WOODFORD MFG. CO. Contractor to select proper model to suit wall construction.

F. Interior hose bibbs shall be WOODFORD MFG. CO., Model 24PC, with Tee Key. Brass construction, chromium plated, with vacuum breaker-backflow preventer.

G. Floor drains shall be type indicated, cast-iron body with nickel bronze strainers. Where waterproof membranes occur, provide clamping collar. ZURN numbers indicated. SMITH or JOSAM may be used.

H. Provide nickel-bronze cleanout access. Where waterproof membranes occur, provide clamping collar. SMITH numbers indicated. ZURN or JOSAM may be used.

Resilient tile floor	4020-U
Painted masonry walls	4402
Ceramic tile floor	4020-U
Carpeted floors	4020-Y
Terrazzo floors	4020-U
Concrete floors	4020-U

I. Provide grease interceptor of size, type and capacity as indicated. Interceptor shall be low type with acid resistant coated interior and exterior fabricated steel and shall have internal air relief bypass,, bronze cleanout plug and visible double wall trap seal with removable pressure equalizing/flow diffusing baffle, fixed bottom outlet baffle and visible double wall trap seal. The secured cover shall be gasketed with center tie down assembly. The grease interceptor shall be complete with external flow control fitting.

2.10 COMMERCIAL ELECTRIC WATER HEATERS

A. Provide electric water heaters of size, type, and capacity as indicated. A.O. SMITH, STATE, RUDD or approved equal.

B. Units shall be listed by Underwriters' Laboratories and approved to the NSF Standard 5 by UL. Models shall meet or exceed the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IESNA 90.1. Heater(s) shall have 150 psi working pressure.

C. All internal surfaces of the heater exposed to water shall be glass-lined with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1400°F to 1600°F.

D. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.

F. The outer jacket shall be of backed enamel finish and shall be provided with full size control compartment for performance of service and maintenance through hinged front panels and shall enclose the tank with foam insulation.

G. Electrical junction box with heavy duty terminal block shall be provided. The drain value shall be located in the front for ease of servicing.

H. Heater tank shall have a three year limited warranty as outlined in the written warranty.

2.11 HOT WATER CIRCULATING PUMPS

A. In-line pumps shall be close-coupled all bronze construction with mechanical seals. Motor shall be open drip-proof. BELL & GOSSETT, or approved equal.

2.12 THERMOMETERS

A. Thermometers shall be provided as indicated. WEKSLER INSTRUMENT, Type "AF."

B. Thermometers in pipelines shall be separable socket 5" dial bi-metal insertion type, with scale suitable for temperature range of medium being measured. Thermometers shall be located to facilitate reading from floor. Angle type shall be used where necessary to facilitate reading. Install thermal well in flow of fluid.

C. Thermometer range shall be 0-200°F for hot water.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Grade horizontal soil, waste, and drain pipes as follows, except as approved and as indicated on drawings:

2"	1/4" per foot, minimum
3" and larger	1/8" per foot, minimum

B. Install vertical soil and waste piping with provision for expansion, and extend full size to and above roof lines as vents, except as otherwise indicated. Where practicable, connect two or more vent pipes together and extend as one pipe through roof at approved locations. Run concealed vent pipes in overhead spaces with horizontal waste or soil piping pitched down to stacks without forming traps in pipes, using required fittings. Where an end or circuit vent pipe from fixture or line of fixture is connected to vent line serving other fixtures, make the connection at least 4'-0" above the floor on which fixtures are located. Vent lines shall not be used as waste, except as approved. Extend cast-iron hub-and-spigot pipe inside of building 6" above the floor.

C. Make changes in pipe sizes on soil, waste, and drain lines with reducing fittings or recessed reducers. Make changes in direction by appropriate use of 45-degree wyes, longsweep 1/6, 1/8, or 1/16 bends, except sanitary tees may be used where permitted by code in soil and waste lines where change in direction of flow is from horizontal to vertical, and on discharge from water closets. Short-radius fittings shall not be permitted, except in approved location.

D. Slip joints are permitted only in trap seals or on inlet side of traps. Use hub fittings for making union connections wherever practicable, in connection with dry vents.

E. PVC piping shall not be installed in return-air plenums, through fire walls, or any location not allowed by the Building Code.

F. All flow measuring and balancing valves shall be balanced for flow indicated by Plumbing Contractor.

3.2 CONNECTIONS TO EQUIPMENT

A. Make plumbing connections to all equipment requiring connections, including equipment in Contract and equipment furnished by others. Make all connections according to manufacturer's recommendations.

3.3 FIXTURE SETTING HEIGHTS

A. Plumbing fixtures shall be at heights indicated and/or directed. Heights of handicapped plumbing fixtures shall be as governed by the Building Code, ANSI A117.1, and the requirements of the Uniform Federal Accessibility Standards (UFAS).

3.4 INSPECTION AND TESTS

A. The entire plumbing system shall be tested by the Contractor in the presence of the Architect. Governing authorities having jurisdiction shall be notified of test required by them, and Final Acceptance of work shall be contingent upon their approval. At least 48 hours notice shall be given prior to test. All costs of conducting test and furnishing necessary equipment for test shall be borne by the Contractor.

B. The entire soil, waste and vent system shall be tested and proved tight prior to connection of fixtures, by closing all openings, except highest at roof, and filling with water to point of overflow. Allow water to stand at least 2 hours before starting inspection. Where piping must be tested in sections to facilitate construction, include at least the upper 10 feet of the preceding section so that no pipe or joint in building will have been subjected to less than 10 feet head of water. Piping laid in trenches shall not be backfilled until test has been made and joints proved tight. Owner shall be provided 24 hours notice prior to tests and provided written results of tests.

C. Upon completion of roughing-in and before setting fixtures, test entire hot and cold water piping system at hydrostatic pressure of 100 psig and prove watertight at this pressure. Test water piping system to be concealed separately in same manner as prescribed for entire system.

D. Thoroughly clean and flush piping and apply chlorine solution to entire system at least 3 hours to destroy nonspore-forming bacteria. Following chlorination, flush agent from system until water is both bacteriologically and chemically satisfactory to Public Health Officer.

E. If inspection or tests show defect, replace such defective work or materials and repeat inspection tests. Make repairs to piping with new materials. No caulking of screwed joints or holes shall be acceptable.

F. Clean equipment, pipe, valves, and fittings of grease, metal cuttings, and sludge accumulated by operations of system for testing. Stoppage or discoloration or other damage to parts of building, its finish or furnishings due to Contractor's failure to properly clean piping system shall be repaired without cost to the Owner.

END OF SECTION 220500

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for fire-service mains.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pipe and fittings.
2. Restrained joints.
3. Fire Hydrant.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

F. NSF Compliance:

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution 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 water-distribution service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.
2. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

3. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.2 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig (1380 kPa).

3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.

b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.

c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.4 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and NPS 6 (DN 150) mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.

a. Standards: UL 246, FMG approved.
b. Pressure Rating: 150 psig (1035 kPa) minimum.
c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Underground Fire-Service-Main Piping NPS 4 to NPS 12 (DN 100 to DN 300) shall be the following:

1. PVC, AWWA Class 150 pipe listed for fire-protection service; ductile iron fittings; and gasketed joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 (DN 80) and larger underground installation.

B. The following requirements apply:

1. Underground Valves, NPS 3 (DN 80) and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

B. Make connections larger than NPS 2 (DN 50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 30 inches (750 mm), with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches (910 mm) cover over top.

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Locking mechanical joints.
2. Set-screw mechanical retainer glands.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve with stem pointing up and with vertical cast-iron indicator post.

3.8 CONNECTIONS

A. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve.

3.9 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Comply with all Newport News Water Works and York County requirements.

D. Prepare reports of testing activities.

3.10 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.11 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.

c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 230100- MECHANICAL GENERAL PROVISIONS

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. This Section forms a part of all Division 22 and 23 Sections.

1.2 APPLICABLE SPECIFICATIONS, CODES, AND STANDARDS

A. Latest effective publications of following Specifications, regulations, standards, codes, etc., as applicable, form a part of these Specifications the same as if written fully herein and shall be followed as minimum requirements.

Codes and ordinances of local governing agencies

AHRI	Air Conditioning, Heating, and Refrigeration Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standard Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronics Engineers
NAFM	National Association of Fan Manufacturers
NEC 2008	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
SMACNA	Sheet Metal and Air-conditioning Contractors National Association
UFAS	Uniform Federal Accessibility Standards
UL	Underwriters Laboratories, Inc.
VFSR	Virginia Fire Safety Regulations
VUSBC	Virginia Uniform Statewide Building Code, 2009 Edition

1.3 DRAWINGS

A. General arrangements of indicated piping, ductwork, and equipment are diagrammatic only, do not scale. Where rearrangement is necessary, submit drawings of proposed changes for approval. Due to scale of drawings, offsets, fittings, and accessories may not be indicated. Work indicated, but having details omitted, shall be provided complete to perform function intended without extra cost. Investigate structural and finish conditions in building affecting plumbing, heating, ventilating, and air-conditioning work, etc., and arrange work accordingly. Furnish fittings, traps, offsets, vents, valves, and accessories required. Install

equipment in accordance with manufacturer's recommendations and clearance requirements.

1.4 COORDINATION

A. Coordinate piping, ducts, and equipment with electrical, structural, and architectural plans and work in order to avoid omissions and to eliminate any interference. Report in writing discrepancies, if found, to the Engineer as soon as possible after discovery.

1.5 WORKMANSHIP

A. Workmanship shall be first class and of best quality in accordance with approved contemporary construction practices. Defective equipment and materials, or material damaged in the course of installation and tests, shall be replaced or repaired in an approved manner.

1.6 CUTTING

A. Cutting shall be carefully done. Repair damage to the building, piping, wiring, or equipment as a result of cutting for installation, using skilled mechanics of trade involved.

1.7 APPROVAL OF MATERIALS, FIXTURES, AND EQUIPMENT

A. See Specification Section 013300, "Submittals," for shop drawing submittal procedures. Within 30 days after award of the Contract and before any purchases are made, submit for approval a complete list of materials, fixtures, and equipment proposed, together with names of manufacturers and catalog numbers for each Specification Section. Furnish other detailed information where directed. No consideration will be given to partial lists submitted from time to time. Approval of materials shall be based on manufacturer's published ratings. Materials, fixtures, and equipment listed which are not in accordance with specified requirements shall be rejected. Contractor shall make resubmission of items not approved within 30 days from date of rejections. Submission shall be complete with description, ratings, dimensions, and related items and any additional information required by the Architect.

B. Materials and equipment shall be new, conforming to these Specifications.

C. Two or more units of same class of equipment shall be product of single manufacturer; however, component parts of system need not be product of same manufacturer.

D. Mechanical design has given full consideration to space requirements for equipment specified. Contractor is responsible for selecting equipment that will be accommodated by this space. Equipment not conforming to space allotted shall be rejected.

E. Mechanical design has given full consideration for electrical requirements for equipment. Contractor is responsible for selecting equipment that will be accommodated by the electrical design indicated. Equipment not conforming to the electrical design provided under Division 26 is the Contractor's responsibility. All electrical changes required to accommodate the equipment provided shall be furnished and installed by the Contractor without change in Contract price or time of completion. This shall include but not be limited to wiring, conduit, circuit breakers, disconnect switches, starters, and controllers.

F. Submit one copy of equipment installation manuals to the Engineer for his use.

1.8 EQUIPMENT DESIGN

A. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, ANSI, IEEE, or other applicable technical standards, suitable for maximum working pressure, and shall have neat and finished appearance.

1.9 SUPERVISION

A. The Contractor for each Section under this Division shall maintain a competent foreman on the job at all times to supervise the work and coordinate with other trades for the installation of the system. Submit foreman's qualifications, including master's trade license, to the Engineer for approval.

1.10 NOTICES AND FEES

A. Give all required notices, obtain all necessary permits (including a separate permit for the installation of refrigerant lines if required by the local "Authority Having Jurisdiction"), and pay all required fees.

1.11 RECORD DRAWINGS

A. Refer to Specification Section 017839 "Project Record Documents".

1.12 OPERATION AND MAINTENANCE MANUALS

A. Refer to Specification Section 017823 "Operation and Maintenance Data".

1.13 OWNER'S TRAINING

A. Upon completion of work and at a time designated by the Architect, the services of competent persons shall be provided as required to instruct Owner's representative in operation and maintenance of systems.

1.14 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the

Specifications shall be free from defects of materials and workmanship for a period of 12 months from date of Substantial Completion.

B. Contractor shall service the systems for 12 months from date of Substantial Completion. Such service shall include all emergency services and adjustments, except cleaning/changing of filters. Adjustments and repairs to equipment shall be made by the original equipment manufacturer (OEM). Third party service agencies are not acceptable for making repairs or adjustments to equipment during the warranty period.

C. Equipment manufacturer and Contractor shall provide a one year material, labor and refrigerant warranty on all compressors. In addition, the manufacturer shall provide an extended 4 year material warranty on all compressors.

D. Contractor shall be responsible for cleaning of hydronic system strainers during the warranty period and provide a report from a water treatment specialist certifying the hydronic systems have been drain, flushed, filled, vented, and chemically treated as required by these specifications and that the system is clean and free of contamination and any other foreign matter and ready for use by the Owner.

1.15 WELDER'S CERTIFICATIONS

A. Submit welder's certifications to the Engineer/Architect for approval.

PART 2 - PRODUCTS

2.1 STEEL AND COPPER PIPE FITTINGS

A. Welding fittings shall be carbon-steel buttwelding type, conforming to ASME B16.9 and B16.28. Flanges shall be carbon steel, conforming to ANSI B16.5.

B. In lieu of welding fittings, BONNEY FORGE "Weldolets," "Sockolets," and "Threadolets" may be used for branch connections when the diameter of the branch connection does not exceed 50% of the diameter of the main.

C. Copper flange adapters (sizes 2" through 6") shall be drilled to ANSI B16.5, 150/125 Standard powder coated with an EPDM insulator adhered to the plate steel flange protruding inside of the steel flange to prevent contact with the copper flange adapter. The copper component of the flange adapter shall be manufactured to ASME B16.22-1995 and Third Party Classified by Underwriters Laboratories, Inc.

D. Copper piping shall be assembled with wrought-copper fittings using 95-5 solder.

2.2 PIPE SLEEVES, PIPE HANGERS, PIPE SUPPORTS, DUCT SUPPORTS, AND FIXTURE SUPPORTS

A. Provide pipe sleeves, hangers, supports, duct supports, and fixture supports. Contractor shall be responsible for proper and permanent location. Pipe and duct

shall not be permitted to pass through footings, beams, or ribs, unless indicated and/or approved.

B. Install pipe sleeves and properly secure in place with grout where pipes pass through masonry or concrete and at all fire-rated assemblies. Pipe sleeves, except in footings, shall be sufficient diameter to provide approximately 1/4" clearance around insulation or pipe. Fill void between insulation or pipe and sleeve with mineral wool to prevent sound transmission. Pipe sleeves in footings or foundation walls shall be cast iron, 4" larger in diameter than pipe installed. Pipe sleeves in walls, floors, and partitions shall be Schedule 40 steel pipe. Extend sleeves above floor at least 1", pack space around pipe with fireproof material, and make watertight. Pipe penetration through below grade walls shall be sealed with modular seals selected for the type of pipe and wall penetration, "LINK SEAL" or approved equal. Where pipes pass through waterproofing membranes, provide flashing sleeves with integral flashing flanges or clamping device of 16-ounce soft-sheet copper; extend at least 8" from sleeve. Thoroughly mop flashing flanges and shields into membrane.

C. Hang horizontal overhead runs of pipe with adjustable clevis-type hangers spaced not over 10 feet apart, except space soil pipe hangers not over 6 feet apart. Provide hangers other than aforementioned, if pipe size or other features make spacing at shorter intervals necessary. Pipe hangers shall be provided within 4 feet of all changes in direction of pipe. Pipe hangers shall not be installed on pipe fittings where fitting could bear the weight of connected pipe but instead shall be installed on pipe at intervals previously specified. Chain, strap, perforated bar, or wire hanger will not be permitted. Hangers shall have short turnbuckles or approved means of adjustment, except turnbuckles may be omitted on hangers for soil or waste pipe from individual toilet rooms to main stack when space does not permit their use. Use spring-type hangers where required. Use trapeze hangers on pipes running parallel and close together. Inserts shall be cast iron or cast steel, of type to receive machine bolt in one horizontal direction and shall be installed before concrete is poured. Support vertical runs of pipe by clamps or collars spaced not over 20 feet apart or as required, except cast-iron soil pipe shall be supported at every floor. Support chromium-plated pipe where required by cast-brass supports finished to match pipe. Hangers for copper tubing shall be copper plated where in contact with tubing. Hangers, including rods and clamps, shall be hot dipped galvanized exterior to the building and in all mechanical spaces, zinc plated in all interior spaces, except as otherwise specified.

D. Gas piping and condensate piping on roof shall be supported by support blocks as required by the Architect.

E. Submit all hangers and accessories to the Engineer for approval. Other materials installed without approved shop drawings shall be rejected.

F. Supports for piping, ductwork, and equipment shall be attached to a structural member, not bridging. Piping, ductwork, and equipment shall not be attached to structural joist bridging or metal roof decking. Provide additional steel supports spanning between joists or beams for hanger attachments. Additional steel supports shall be approved by the Structural Engineer.

G. In areas supported by steel beams, secure hanger rods directly to beams.

H. Beam clamps shall be permitted to be attached to the bar joist provided that they do not exceed 150 lbs per hanger.

I. Support vertical lines from lowest story with base fittings set on concrete or brick pier or by hangers and supports where directed.

J. Provide galvanized steel shields or protection saddles to protect insulation at area of contact with hangers and supports. Where shields are used on pipes 1-1/2" and larger, provide insulation inserts at points of hangers and supports. Refer to Section 230700 for details.

K. Support and fasten fixtures and equipment in an approved manner.

L. Ductwork shall be supported in accordance with SMACNA, HVAC Duct Construction Standards, unless otherwise noted or indicated. Suspended ductwork shall be supported using threaded rod or solid metal strap as required by SMACNA. No other materials, such as perforated metal strap, or cloth strap, are acceptable. Wire may be used to hang round duct smaller than 10"; however, solid metal strap shall be used to wrap around duct. Wire shall not be used for rectangular duct or round duct larger than 10". Rooftop ductwork supports shall be spaced a maximum of 4'0" apart.

2.3 DUCT AND PIPE PENETRATIONS THROUGH FLOORS, WALLS, AND CEILINGS

A. Fit exposed pipes passing through floors, finished walls, or finished ceilings with escutcheon of chromium-plated cast-brass plates on chromium-plated pipe, nickel-plated steel plates on ferrous pipe, or copper tubing. Plates shall be large enough to completely close hole around pipes and conceal pipe sleeves and shall be round, with least dimension at least 1/2" larger than diameter of pipe and insulation. Secure plates in an approved manner.

B. Fit ductwork passing through floors, walls, or ceilings with 22-gauge galvanized sheet-metal sleeves. Sleeves shall be large enough to completely close hole around duct and shall be at least 1/2" larger than outside dimensions of duct and insulation. Provide flanges on both sides of penetrations to cover the wall edge. For uncovered ducts, sleeves shall be of same material as duct. Secure sleeves and flanges in an approved manner.

C. Ducts passing through fire walls, smoke partitions, fire partitions, or floors shall be sealed with a UL rated system appropriate for the specified fire rating.

D. Pipes passing through firewalls, smoke partitions, fire partitions, or floors shall be sealed with a UL-rated system appropriate for the specified rating.

2.4 UNIONS

A. Unions shall be installed on each side of all control valves, regulators, and similar items and one side of all pieces of equipment, such as pumps, tanks, etc., so that such equipment shall be readily disconnected and removed if necessary.

B. Unions shall not be concealed in walls, ceilings, or partitions.

2.5 DIELECTRIC CONNECTIONS

A. Dielectric connections shall be provided at all connections between ferrous and nonferrous piping or metals, except drain piping connections at drain pans for cooling coils and valves having cast-bronze adapters.

2.6 ELECTRICAL WORK FOR EQUIPMENT UNDER MECHANICAL SYSTEMS

A. All non-integrated motor controllers and starters serving equipment installed under Division 23 Sections shall be furnished under those Sections and shall be turned over to Electrical Contractor, for installation by Electrical Contractor. Controllers shall be equipped with all auxiliary contacts, poles, or devices necessary to permit inter-locking and control required.

B. Fractional horsepower motors 1/2 HP and below shall be single-phase, 60 cycles, 120V; motors larger than 1/2 HP shall be 3-phase, 60 cycles, of voltages indicated on the electrical drawings, and conforming to the electrical service, except where indicated otherwise. Motors shall conform to latest NEMA requirements.

C. All electrical power wiring required for equipment installed under Division 23 Sections shall be provided under Division 26 Sections with all necessary approved wiring diagrams and guidance provided under Division 23 Sections, with the exception of power wiring to Automatic Temperature Control panels which shall be provided by the Automatic Temperature Control Contractor.

D. Raceways shall be 1/2" minimum. All wiring in rooms with exposed structure shall be installed in conduit. Label the front face of the cover on each junction box with indelible black marker indicating the number of each circuit contained in or running through the box. In areas where exposed construction is the final finished condition and conduit and junction boxes are called out to be painted, label the inside face of the covers.

E. All control and power wiring required for temperature control system and all interlocking and accessory control wiring required for equipment installed under Division 23 Sections shall be installed by the Plumbing, Mechanical, and Temperature Control Contractors. All low voltage wiring terminations shall be contained in a junction box.

F. Three-phase motors shall have magnetic across-the-line starters unless hereinafter indicated or required by Power Company to be otherwise. Provide overload relay in each phase or motor lead. Operation of any overload relay shall simultaneously open all phases.

G. Manual starters shall be manual single-, double-, or three-pole type designed for flush or surface mounting, with overload protection in each phase.

H. Starters for motors under automatic control shall have built-in "hand-off-auto" selector switch.

I. Push-button stations shall have "start-stop" momentary contacts, having one normally open and one normally closed set of contacts, with indicating lights to indicate when motors are running. Stations shall be heavy-duty type designed for flush or surface mountings as required.

J. All starters and controls shall be NEMA rated and NEMA I enclosed where mounted inside building, except in kitchens which shall be NEMA 4X-SS. Starters and controls mounted outside or where specifically called for shall be NEMA 3R. Explosion-proof enclosures shall be used in hazardous areas and where specifically called for. Combination switch and magnetic starters shall be provided where indicated.

K. Auxiliary 120-Volt contacts shall be provided to give control and interlocking as required or as indicated.

L. Where control voltages are different from motor voltages, a control-voltage transformer shall be provided as a part of the starter.

M. The Contractor shall be responsible for coordinating with the Division 26 Contractor for providing properly sized circuit breakers to serve equipment and motors furnished which differ from that specified or indicated. This shall be further understood to include branch circuit wiring, conduit, disconnect switches, etc., in accordance with the appropriate codes and specifications. The cost of providing this increased electrical service and related work shall be included under the applicable section under which the equipment and motors are being furnished, at no additional cost to Owner.

N. The Automatic Temperature Controls Contractor shall be responsible for providing circuit breakers and power wiring and conduit from electrical panels installed under Division 26 to Automatic Temperature Controls panels.

O. The Mechanical Contractor shall be responsible for the installation and mounting of all duct smoke detectors in new and existing ductwork. The duct smoke detector shall be furnished and provided with all fire alarm wiring under Division 26. Any and all Temperature Control wiring shall be provided under Division 23. Refer to the mechanical drawings for locations in new ductwork. Refer to the electrical drawings for locations of existing detectors to be replaced. Coordinate the installation of the detectors with the Electrical and Automatic Temperature Control Contractors.

2.7 MACHINERY ACCESSORIES

A. Provide oil-level gages, grease cups, and grease-gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating

means are not easily accessible, extend to locations as directed. Furnish all grease-gun fittings of uniform type.

2.8 WALL, PARTITIONS, AND CEILING ACCESS DOORS

A. The Contractor shall furnish and the General Contractor shall install prime coated steel access doors with lock where required, style necessary for surface in which placed, sizes as indicated or required for access to equipment, valves, dampers, filters, duct smoke detectors, and all other devices requiring access ACUDOR PRODUCTS, INC. model UF-5000 (SCPC – prime coated) or approved equal.

B. Access doors shall have same fire rating as ceiling, floors, walls, and partitions in which installed.

2.9 AIR BALANCING DEVICES

A. Furnish any additional material or equipment, such as sheaves, belts, motors, and balancing devices, required to complete and/or adjust and balance the systems as recommended by the TAB Agency at no additional cost to the Owner. Failure to provide additional means of adjusting and balancing will not relieve the Contractor of responsibility for properly adjusting and balancing the various systems as intended.

2.10 DUCT SEALANT

A. Where duct is indicated to be sealed, utilize a fire resistive, water based, indoor/outdoor, U.V. resistant, non-fibrated duct sealant, DUCTMATE EverSeal, FOSTER DUCT-FAS 32-19 or approved equal.

B. Sealant shall have a volatile organic compound (VOC) rating of 24 g/L, less water.

C. Sealant shall meet all SMACNA pressure classes up to 10" w.g. and SMACNA seal classes A, B, and C.

D. Apply sealant with brush working sealant into all joints. For spiral duct, apply sealant to male end of coupling prior to fitting straight run of duct to coupling. Follow manufacturer's instructions for all application requirements.

E. The use of duct sealing tape of any kind is unacceptable.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Pipe systems shall be complete. Pipe shall be of size indicated or, where not indicated, shall be of size required to produce capacities of the equipment specified. No pipe shall be buried in floors, unless specifically indicated or approved.

B. Install runs of piping as indicated. Cut pipe accurately to measurements established at the building by the Contractor and work into place without springing or forcing. Do not cut or move any structural portions of the building without approval. Run piping above ground, parallel with lines of buildings, unless otherwise shown or specified.

C. Install piping to allow for expansion and contraction, using offsets, swing joints, expansion joints, anchors, and related items as may be necessary. Make connections to coils, pumps, and other equipment in such manner as to eliminate undue strains in piping and equipment and to prevent noise transmission. Provide necessary fittings and bends to avoid springing of pipes during assembly. Weld expansion loops using long-radius ells. Make changes in pipe sizes with reducing fittings.

D. Pipe outlets of vent valves, safety valves, drip pans, overflow drains, condensate drains, backflow preventers, and other drain points to floor drain unless otherwise indicated. Gages, thermometers, and related items shall be carefully leveled. Thoroughly clean and flush piping in presence of the Engineer, as installed and before automatic vents are installed.

E. Unless otherwise indicated, connections to equipment shall be as shown by manufacturer's data. Make piping connections to equipment with unions or flanged connections arranged so that equipment can be dismantled without disturbing the piping installation. Unions shall be accessible after building is complete. Provide valves to isolate equipment for service or removal.

F. Run horizontal water piping with pitch of at least 1" in 40'-0" and arrange to drain to minimum number of low points. Equip low points with drain valves and hose nipples not smaller than 3/4". Eccentric reducing fittings or eccentric reducing couplings must be installed where indicated or as required to bring bottoms of mains in line and prevent pockets.

G. Close pipe openings with caps or plugs during installation. Cover fixtures and equipment tightly and protect against dirt, water, and chemical or mechanical injury. Carefully free interior of pipe of superfluous material as work progresses. Upon completion of work, thoroughly clean fixtures, materials, and equipment and deliver in approved unblemished condition. Pitch closed loop water piping to vent at high points. Provide a manual air vent ball valve at all high points in the piping system.

H. Lay pipe true to line and grade with bells up-grade so pipe will have smooth and uniform invert. Keep pipe thoroughly clean so jointing compounds will adhere. Inspect each pipe section for defects before lowering into trenches. Allow no water in trenches during pipe laying or around joints until compound has set.

I. Ream pipe after cutting and before threading and remove burrs. Make screwed joints with graphite and oil or approved graphite compound applied to threads only. Cut threads full, and not more than three threads on pipe shall remain exposed. Caulking of threaded joints to stop or prevent leaks will not be permitted. Provide unions where required for disconnection. Use swing joints for branch connections to risers and mains.

J. Make copper tubing sweat joints with noncorrosive flux and lead-free solder recommended for service encountered or as indicated.

K. No joint shall be made under water. Secure watertightness and prevent damage or disturbing of joints during refilling process, or at other times after pipes have been laid, and joints made. Do not walk or work over pipes except as necessary in tamping until at least 2" of covering has been placed over pipe. Uncover joints showing leaks; remake joint at Contractor's expense.

L. The Contractor may, except at unions, weld pipe 2-1/2" and larger, using welding fittings. Welding material and labor shall be in accordance with an approved procedure conforming to ASME B31.9 Building Services code. Welders shall be fully qualified by an approved Welding Bureau or locally recognized testing authority. Welding shall be electric arc welding method. Welding of pipe inside the building shall not be permitted without approved ventilation. Galvanized pipe shall have the galvanizing ground from the heat affected zone.

3.4 EQUIPMENT INSTALLATION

A. Erect equipment in neat and workmanlike manner. Align, level, and adjust for satisfactory operation. Install so that connecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation, maintenance, and repair. Minor deviation from indicated arrangements may be made as approved by Engineer.

3.5 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over building areas. Conform to applicable technical societies' standards, also to codes and regulations of agencies having jurisdiction. Obtain approval before fabrication.

B. Fasten wall-mounted or ceiling-hung equipment to building structures or inserts as approved.

C. Where concrete foundations or pedestals are indicated or required, use concrete mix, reinforcement where required, and methods as specified under Section 033000, "Cast-In-Place Concrete."

D. Where floor is waterproofed, construct foundation so that anchor bolts will not pierce waterproofing.

E. Finish exposed parts of concrete foundation with cement mortar. Fill voids, trowel smooth, bevel edges and corners to make neat appearance.

F. Finish exposed parts of concrete foundation with cement mortar. Fill voids, trowel smooth, bevel edges and corners to make neat appearance.

G. Provide adequate supports for roof-mounted mechanical equipment. Supports shall keep equipment clear of roof and transmit weight to roof structure as approved by Engineer.

3.6 NOISE AND VIBRATION

A. Mechanical and electrical equipment shall operate without objectionable noise or vibration as determined by the Architect.

B. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building by apparatus, piping, ducts, or other parts of mechanical and electrical work, make necessary changes and additions as approved, without extra cost to the Owner.

C. Isolators shall prevent, as far as practicable, the transmission of vibration, noise, or hum to any part of building.

D. Isolators shall suit vibration frequency to be absorbed. Provide isolator units of area and distribution to obtain proper resiliency under load and impact.

3.7 FLASHING

A. Provide cap flashing for roof-mounted fans.

3.8 PROTECTION OF EQUIPMENT AND MATERIALS

A. Responsibility for care and protection of mechanical equipment rests with Contractor until Substantial Completion of the work.

B. After delivery, before and after installation, protect equipment and materials against theft, injury, the environment, or damages from all causes.

C. Protect plumbing fixtures and other equipment with enamel or glaze surfaces from damage by covering and/or coating as approved.

D. Protect equipment outlets and pipe openings with temporary plugs or caps.

E. During construction, seal off all openings into interior of equipment and ductwork with sheet metal or taped polyethylene sheathing to prevent infiltration of dust.

F. Temporary (MERV 8) filters shall be provided a minimum of every 30 days for all fans that are operated during construction, and new (MERV 8) filters shall be installed after all construction dirt has been removed from the building just prior to testing and balancing. Following the testing and balancing, (MERV 8) filters shall be provided a minimum of every 30 days for all fans that are operated during construction. Just prior to Final Completion, all filters shall be replaced with the final (MERV 8) filters. Ducts shall be inspected for dust and dirt. Contractor shall provide a signed statement to indicate that new filters for each piece of equipment were installed just before Final Completion. Construction filters shall be removed and not be used as the final set of filters. The contractor shall keep a filter replacement log that includes equipment identifications and dates of filter installation. Log shall be provided to the Engineer and Owner for review on a monthly cycle. Should the Contractor fail to comply with the filter changes as specified, the Owner may, at his discretion, hire through a separate contract the specified filter changes and withhold the cost for this work from the construction contract amount as a back charge to the Contractor.

G. Provide a spare filter (or sets of filters for equipment that require multiples) for each piece of equipment. Turn filters over to Owner with proper transmittal prior to Final Completion.

H. Equipment not designed for exterior installation (i.e., Water Source Heat Pumps, VRF Indoor Units, Pumps, etc.) shall not be delivered to the job site until a location protected from the environment is provided. Location must be approved by the Architect and Engineer prior to delivery.

I. Equipment suitable for exterior installation (i.e., Rooftop Ventilation Unit, Exhaust Fan, etc.) shall not be delivered to the job site until it is ready to be installed in its permanent location.

3.10. CONTRACTOR'S RESPONSIBILITY FOR MANUFACTURER'S AUTHORIZED FIELD START UP:

A. The equipment manufacturer shall furnish a factory-trained and certified service technician without additional charge to start the HVAC equipment. This individual's certifications shall be submitted as a shop drawing along with the equipment and shall be reviewed and approved by the Engineer. Unit manufacturers shall maintain service capabilities no more than 100 miles from the job site.

B. The HVAC equipment to be started by the manufacturer's certified technician shall include: packaged rooftop ventilation units and variable refrigerant flow systems.

C. The manufacturer shall furnish complete submittal wiring diagrams of the HVAC equipment as applicable for field maintenance and service.

D. Start up sheets on all equipment shall be submitted and reviewed by the engineer. An approved copy shall be included in the final TAB report. If required, this

same representative shall be made available to review the startup sheets onsite with the Engineer and Owner.

3.11 CONTRACTOR'S RESPONSIBILITY FOR TESTING, ADJUSTING, AND BALANCING (TAB)

A. Provide the TAB Agency a full set of Contract Documents (drawings and technical specifications), all manufacturers' approved submittal data, and copies of revised data as soon as possible.

B. Ensure that a current TAB Engineer's certification certificate is kept on file.

C. Ensure all systems have been installed and are in 100% working order before the TAB Engineer is called to the job site, including but not limited to ductwork, piping, terminals, electrical, and ATC. The Contractor shall verify that each item of the Pre-TAB Checklist (see Appendix A) has been completed, and shall deliver a signed copy of the Pre-TAB Checklist to the Owner's Representative and the TAB Agency attesting that the project is complete and ready for TAB work to begin.

D. Ensure that all ductwork requiring SMACNA – ADLTM duct leakage testing has been tested in the presence of the TAB Engineer and Owner's Representative and has met the referenced requirements.

E. Provide adequate access to all points of measurement and adjustment and ensure that all dampers operate freely.

F. Provide a factory representative for all major pieces of equipment as requested by the TAB Agency to assist in operation and performance verification of equipment.

G. Cooperate with the TAB Agency to help operate and adjust the control systems directly related to TAB work and provide any specialties required to make such adjustments.

H. Carefully review the drawings and Specifications for the various systems noting all facilities incorporated in the design for purposes of adjusting and balancing. Should it be deemed necessary to provide additional dampers, baffles, valves, or other devices which would aid in the required adjusting and balancing, same shall be provided by the installing contractor.

3.12 CLEANING, PAINTING, AND IDENTIFICATION

A. Remove from site excess material, equipment protection, etc. Thoroughly clean piping, hangers, equipment, fixtures, and trimmings and leave every part in perfect condition ready for use, painting, or insulation as required.

B. Paint exterior surfaces of equipment supports and other ferrous metal work, except that which is galvanized, with one coat of RUSTOLEUM damp-proof red primer, or approved equal.

C. Piping service and flow direction shall be indicated with vinyl labels which identify the service by name (not initials) and the flow direction by arrows. Labels shall be

used wherever piping is exposed, except in finished spaces, and at all unit connections. For concealed piping located above accessible ceilings, label piping at 25-foot intervals with painted stencil-type lettering. Label and arrow heights shall be proportional to pipe sizes as follows:

Insulated and Un-insulated Pipe Size	Label Heights
Up to 1"	1"
1-1/4" to 2"	2"
2-1/2" to 4"	3"

D. All valves in equipment room(s) shall be identified with 1-1/2" diameter, permanently stamped, brass tags. Secure tags to valve item or wheel with brass jack chain or copper meter seals. Provide framed and mounted, under clear plastic, valve chart (8-1/2 x 11 min.), identifying valve number by system served and function.

E. Provide color-coded identification dots affixed to the ceiling grid for equipment, access doors, terminal equipment controllers, smoke detectors, filters, and valves concealed above ceilings. Provide a color-coded chart identifying type of equipment or valve. Chart shall be framed and mounted, under clear plastic, and located as directed by Owner.

3.13 EQUIPMENT MARKING

A. Label all mechanical equipment, including starters, control panels, fans, pumps, and air-handling equipment.

B. Labels shall be machine engraved, laminated, 1/8" thick, Bakelite, nameplate type. Labels shall be black faces with white letters.

C. Labels shall have 1/4" high letters.

D. Labels shall be rigidly attached using rivets or screws. Adhesive backing is not acceptable.

APPENDIX A

PRE-TAB CHECKLIST

A. GENERAL

1. All components of the HVAC system have been installed, including controls and control wiring.
2. Power wiring has been installed and energized to all motorized equipment. Also, all line voltage control wiring required has been installed.
3. All equipment has been started and run tested through all specified sequences of operation by factory-authorized representatives and all safety controls have been verified to be operational.
4. All required testing of piping and duct systems has been completed in accordance with the drawings and specifications.

B. HVAC WATER DISTRIBUTION SYSTEMS

1. Piping systems have been flushed thoroughly, strainers have been removed, cleaned, and replaced as required. There is no evidence of plugged piping, coils, heat transfer equipment, valves, or flow measuring devices.
2. All air has been vented from the hydronic piping systems, equipment, and coils.
3. Pressure reducing/regulator valves in make-up water piping have been set for the required fill pressure of each hydronic system.
4. Correct pump rotation has been verified. Pumps are not cavitating. Vibration isolators and flexible connectors have been installed where required. Vibration is not excessive with pumps operating. Pumps have been lubricated.
5. All control valves are installed and functioning properly according to the specified sequences of operation.
6. All required pressure, temperature, and flow measuring devices and balancing valves have been installed. All taps and adjustment dials are accessible and adequate clearances have been provided for connection of instrument hoses and adjustment taps, dials, and scales are free of paint, insulation mastic, and other foreign matter.
7. System contains correct amount of water treatment chemicals and glycol where required.

C. AIR DISTRIBUTION AND VENTILATION SYSTEMS

1. All air system filters have been replaced with new filters. The air moving equipment, ductwork, and air terminals are installed and connected. All air systems are unobstructed and free of debris.

2. All manual volume control dampers required are installed and properly connected to adjustment handles. All damper handles are accessible and not covered by insulation or draw bands. All automatic dampers required have been installed with linkages connected and adjusted to provide the specified sequence of operation.
3. Access doors have been installed where required to allow inspection and servicing of duct-mounted dampers, equipment, and components.
4. All ductwork and connections of duct to air terminals have been checked, and no visible or audible leakage exists.
5. Fans are rotating in correct direction. Fans have been lubricated. Drive pulleys are aligned and belt tension is correct. Setscrews are tight securing keys into key-ways. Fan wheels turn freely and are balanced. Belt guards are in place.
6. Vibration isolators and flexible connectors have been installed where required. With fans in operation, there is no excessive vibration of fan assemblies or ductwork.

I, , an authorized representative of ,
(Signature and Title) (Company)

attest that all items contained in the above Pre-Tab Checklist have been completed

and verified as of this date:_____.

END OF SECTION 230100

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SECTION 230500 – HEATING, VENTILATING, AIR CONDITIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 230100, "Mechanical General Provisions," apply to this Section.

B. Refer to Specification Section 230900, "Automatic Temperature Controls," for additional requirements and coordination between equipment and controls.

1.2 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of material and workmanship for a period of 12 months from date of Substantial Completion of the building. Refer to Section 230100 for additional warranty period responsibilities.

1.3 SUBMITTALS

A. Submit manufacturer's performance data and unit details on all products specified below or indicated on drawings.

1.4 PROTECTION OF EQUIPMENT AND MATERIAL

A. All equipment and material not specifically designed for exterior installation shall not be delivered to the job site until an indoor, dry location is available for storage. All equipment and material shall be covered and protected from dirt, debris, moisture, paint, coatings, and damage of any kind. Store off the floor, in a location approved by the Owner, to prevent contact with water.

B. All air-conveying equipment and material, including but not limited to ventilation air unit, heat pumps, diffusers and ductwork, shall be kept clean as described above, and all airside surfaces shall be wiped clean (metal surfaces) prior to installation. Where equipment surfaces are subject to additional accumulation of dirt and debris, interior cleaning shall be done after the completion of ductwork installation at all unit openings.

1. Exterior surfaces of all equipment shall be cleaned at completion of construction in a manner that condition and appearance of equipment is the same as it left the factory.
2. No equipment shall be run without approval by the Engineer. The Contractor shall provide temporary filters for all intakes and return connections to air-conveying equipment at his own expense during the construction process in accordance with Specification Section 230100. Filters shall be changed every 14 days regardless of condition. The Contractor assumes full responsibility for cleanliness of all equipment operated during the construction period and any ductwork used to

convey air during construction prior to meeting Substantial Completion. The Contractor shall clean all equipment to like-new condition as it appeared when it left the factory prior to substantial completion. All damages shall be repaired/replaced at the Contractor's expense.

PART 2 – PRODUCTS

2.1 HEAT GENERATION (Not Used)

2.2 REFRIGERATION (Not Used)

2.3 AIR HANDLING EQUIPMENT

A. Rooftop Ventilation Unit (RVU-1) – Base Bid and Alternate Bid 1

1. Provide size, type, and capacity packaged rooftop ventilation unit as indicated. Ventilation unit shall be constructed and weatherproofed for outdoor application and shall be packaged DX unit with total energy wheel, hot gas reheat and natural has heater. Units shall be as manufactured by ENGINEERED AIR. NO SUBSTITUTIONS

2. Unit Construction:

1. Unit casing shall be of minimum 18 gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be polyurethane and applied to all exposed surfaces. All unprotected metal and welds shall be factory coated. Color shall be determined by the owner.
2. All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.
3. The unit shall be provided with a 22 gauge solid galvanized metal liner over insulated areas including unit underside.
4. Unit shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, burner, compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
5. Unit shall be provided with hinged access doors which open outwards on all sections. Doors located on sections with positive pressure shall have a red warning label and a safety device must be affixed.
6. All hinged access doors shall include welded steel frames. Doors shall be fully lined, come complete with bulb trim seal gasket and Leverlok handles, operable from both sides. A;; doors shal have two (2) handles internally linled to allow access with the use of one (1) handle. Doors utilizing continuous piano hinges must include stainless steel hinge assemblies. Pre-manufactured, non-thermal,

2" double wall doors as manufactured by AJ Manufacturing Inc. will be considered equal. Unit manufactures standard door construction will not be considered equal.

7. Unit shall be internally insulated with 2" thick nominal 3 lb./cu.ft. density acoustic insulation.
8. Insulation shall be secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
9. Cooling coil drain pan shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 2" deep, with welded corners. Drain pan shall extend a minimum of 6" downstream of coil face and be provided with a 1 ½" S.S. M.P.T. drain connection. Drain pan must have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pan shall be provided between cooling coils where required for effective moisture removal.
10. The floor is to act as drain pan complete with 2" upturn standing seams around perimeter (or 2" perimeter collar continuously welded to the unit base) and welded corners to ensure the floor is watertight. Alternately screwing down, tack welding and caulking of this collar is not acceptable. Provide 1" drain connections for complete drainability of the base pan.
11. The leaving side of the energy wheel section, supply and exhaust, shall be provided with a drain pan and shall be an integral part of the floor paneling, a minimum of 2" deep, with welded corners. Drain pan shall extend a minimum of 24" downstream of the wheel face and be provided with a 1" M.P.T. drain connection.
12. Packaged rooftop unit shall be weatherproofed and equipped for installation outdoors. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intake and exhaust openings with 1" galvanized inlet screens; roof shall be sloped ¼" per foot and include rain gutters with downspouts on the low side (diverters over access doors will not be acceptable); all joints caulked with a water resistant sealant; roof joints turned up 2" with three break interlocking design; outer wall panels extend a minimum of ¼" below the floor panel; drain trap(s) connections for field supply and installation of drain traps.
13. Unit shall incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked. Units that screw or bolt components through the floor are not acceptable. All penetrations in the unit floor must be made through the specified factory utility chases.
14. Provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 12" high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 1" upturn on inner perimeter, to provide a complete seal against the elements. External insulation of the roof-mounting curb shall be provided by the Roofing Subcontractor.

3. Fans

    1. Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.
    2. Supply fan shall be plenum type configuration. Thrust restraint isolators shall be provided parallel to the shaft centerline to minimize axial movement and bending movements of the blower assembly. Drive side bearings on plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.
    3. Exhaust fan shall be single low pressure forward curved and shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings.
    4. Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly. Motor mounting shall be adjustable to allow for variations in belt tension.
    5. Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The unit shall incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" static deflection. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.
    6. Drives shall be adjustable on fans with motors 7 1/2 HP or smaller. All drives shall be provided with a rust inhibiting coating.
    7. Fan motors shall be ODP (open drip proof) super high efficiency.
    8. Provide factory mounted and wired variable frequency drives on all supply motors and exhaust motors for units with energy recovery. Drives shall be as manufactured by ABB no substitutions. Unit manufacturer is responsible for sizing.

4. Coils

    1. Coils shall be 1/2" O.D. for evaporator and 3/8" O.D. for condensing as manufactured by Engineered Air, constructed of copper tube, aluminum fin, copper headers/distributors and galvanized steel casing.
    2. Fins constructed of aluminum shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig while immersed in an illuminated water tank.
    3. The refrigerant evaporator coil shall be equipped with distributors connected to the coil by copper tubes. Refrigerant coils shall be alternate tube circuited in order to distribute the cooling effect over entire coil face at reduced load conditions. Hot gas bypass

inlet shall be at the refrigerant distributor. Provision for use of thermal expansion valves must be included for all circuits.

4. Refrigerant reheat coil shall be installed downstream of the evaporator coil. A minimum 24" access section shall be located between the evaporator coil and reheat coil (coils shall not be installed directly adjacent to one another). The reheat coil shall be sized to handle the total heat of rejection from (1) one individual refrigeration circuit to achieve the scheduled leaving air temperature. Control of the reheat coil shall be by a stepper valve for full modulation of the reheat (on/off control is not acceptable).
5. Headers shall be inside the air handling unit. Provide auxiliary drain pan complete with ½" MPT drain connection at headered end of cooling coils. The non headered end of the coil shall be fully concealed.
6. Coil shall be removable from the unit at the headered end, unless shown otherwise on the drawings.
7. Access between coils and major components shall be no less than 24 inches.
8. All exterior coils shall be protected with hail guards.

5. Gas Heat Section – indirect Fired

1. Heating units shall be indirect natural gas fired approved for both sea level and high altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.
2. All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire operation.
3. Operating natural gas pressure at unit(s) manifold shall be 7"w.c..
4. Gas manifolds shall be provided to FM standards.
5. Heat Exchanger/Burner Assembly
   (1) Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1" of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.
   (2) Unit shall incorporate a high efficiency heat exchanger tested and certified to ANSI/CSA standards to provide a minimum of 80% efficiency throughout the entire operating range as required by ASHRAE 90.1. The manufacturer shall be routinely engaged in the manufacture of this type of high efficiency equipment.

(3) The heat exchanger/burner assembly shall be a blow through positive pressure type. Unit shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.
(4) Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.
(5) The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges. The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.

6. Venting provisions must be in accordance with CAN/CSA Standard B149.1, ANSI Z223.1-NFPA 54, and local authorities having jurisdiction. Standard outdoor DJS provided with stainless steel flue extension

6. Recovery Air Total Energy Wheel

1. Provide an ARI Certified Recovery Air wheel. The performance of the wheel is to be ARI tested and certified as an individual component. The effectiveness shall be reflective of the component performance only without the benefit of packaged equipment.
2. The wheel shall be a minimum of 10 inches in depth, constructed of sheet aluminum, with alternate layers glued to each other for stability. Wheels shall be tension wound on to a central hub. All aluminum surfaces shall be coated with a "zeolite" 4 Å molecular sieve coating to provide water vapor transfer from one air stream to the other. The wheel shall be cleanable with compressed air without damage to the aluminum or desiccant. Alternate reclaim devices shall meet or exceed the performance noted in the schedules without exceeding the fan power requirements specified.
3. Wheels are held securely together with metal spokes extending radially from the hub to the peripheral banding. Spokes are flush mounted to rotor media. Wheels shall be provided in one piece construction.
4. The wheel shall be supported by two pillow block bearings which in turn are supported by a steel support. The bearings shall be located in the shadow of the bearing support member and the division between air streams to maximize the free area of the rotor as much as possible. The bearings shall be replaceable without removing the wheel from the air handling unit.
5. Wheels shall be provided with non-contact labyrinth seals around the perimeter of the wheel and across the face at the division between the supply and exhaust sectors. Brush style

seals will not be acceptable. Adjustable seals shall be spaced not more than 1/32" from the rotor surface.

6. The unit shall be provided with a purge system to allow a percentage of outdoor air to sweep through the exhaust air sector to eliminate the possibility of exhaust air to the supply air stream.
7. The manufacturer shall ensure that the pressure at the entering side of the exhaust air sector of the wheel is lower than the pressure at the entering side of the supply air sector. In the case of draw-through fans, this will necessitate a field adjustable damper in the exhaust system upstream of the total energy wheel. The manufacturer shall select the supply and exhaust fans to provide the additional air for purge where required.
8. The wheel shall be driven by a continuous V-belt around the outer perimeter of the wheel connected to a 3 phase, inverter driven, high torque/high turndown, AC motor for variable speed applications. Access to the motor and the drive shall be from the face of the wheel.

9. Variable Speed Control:

   (1) Provide a solid state control system, to provide discharge air temperature control, free-cooling function, summer-winter changeover, and prevention of frost formation on the wheel when necessary
   (2) An adjustable set point on the face of the controller shall allow a selection of 52°F to 74°F discharge air temperature. In the heating mode, as the discharge air temperature nears the set point, the speed of rotation of the wheel is slowed to maintain set point. When the minimum speed is reached, and there is a cooling demand, the wheel will stop completely. The wheel will remain off until the outdoor air temperature exceeds the exhaust air temperature, at which time the wheel will resume operation at full RPM.
   (3) The frost prevention mode overrides the temperature control mode and shall be enabled when the outdoor air temperature drops below the frost threshold. The wheel speed shall be controlled to maintain a specific dry bulb temperature in the exhaust air that coincides with 90% RH. The calculated value is based on the estimated space RH, which shall be a selectable feature on the controller.

7. Refrigeration

1. Rooftop unit shall be ETL approved and operate down to 50°F ambient as standard. Unit shall have multiple compressors. All refrigeration circuits shall be equally sized and separate from each other. Refrigeration circuits shall be complete with liquid line filter-driers, service ports fitted with Schraeder fittings, load compensated thermal expansion valves with external equalizers, combination sight glass moisture indicators, automatic reset low pressure control, manual reset high pressure control and insulated suction lines.

2. The complete piping system shall be purged and pressure tested with dry nitrogen, then tested again under vacuum. Unit shall then be factory charged with R-410a refrigerant. Each system shall be factory run and adjusted prior to shipment.
3. The hot gas reheat circuit shall include check valves, stepper valve, receiver, flash intercooler, liquid line solenoid, hot gas bypass line solenoid and accumulator.
4. Hot gas bypass shall be provided on the lead compressor to maintain adequate suction pressure in the event of low loads. Hot gas bypass used for capacity reduction shall not be acceptable.
5. Compressors shall be scroll type, 3600 RPM, set on resilient neoprene mounts and complete with line voltage break internal overload protection, internal pressure relief valve and crankcase heater.
6. Compressors shall be located in a service enclosure complete with hinged access doors with Leverlok handles for ease of service. The enclosure shall match the construction of the unit.
7. Unit shall have a minimum of (3) three individually circuited compressors.
8. Compressors shall be provided with a 5-year extended warranty.
9. Condenser fans shall be direct driven propeller type arranged for vertical draw through airflow. Motors shall be weather resistant type, with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted on a formed orifice plate for optimum efficiency with minimum noise level.
10. Controls shall include compressor and condenser fan contactors and overload protection, control circuit transformer, cooling relays and ambient compressor lockout. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.
11. Provide five minute anti-cycle and interstage time delay timers.
12. Equipment manufacturer shall provide a unitary electronic temperature control system with the capability of providing up to 3 stages of cooling control to maintain discharge temperature. The minimum run and off time for compressors shall be 4 minutes at full load start up, and may range up to 8 minutes under part load conditions. The controller shall incorporate a PI (proportional/integral) control scheme that reduces temperature drop by resetting to the set point after each stage is cycled on. The controller shall be able to accept a reset signal from the building management system. Third party control systems to achieve the required function, installed at the factory or in the field, are not acceptable.

8. Filters

1. Filter sections shall be provided with adequately sized access doors to allow easy removal of filters.
2. Filters shall be lift out from an access plenum upstream of the filters. Lift out 2" filters shall fit into a horizontal track from which they are lifted up and out (face load).

3. 2" Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. The filter media shall have a minimum efficiency of 30%- 35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

9. Dampers

1. Damper frames shall be 5" x 1" x .125" (minimum thickness) 6063T5 extruded aluminum hat channel with hat mounting flanges on both sides of the frame. Each corner shall be reinforced with two die formed internal braces and machine stacked for maximum rigidity.
2. Blades shall be airfoil type heavy gauge extruded aluminum with integral structural reinforcing tube running full length of each blade. Blade edge seals shall be extruded double edge design with inflatable pocket which enables air pressure from either direction to assist in blade seal off. Blade seals shall be mechanically locked in extruded blade slots, yet shall be easily replaceable in field. Adhesive or clip-on type seals are unacceptable.
3. Bearings shall be non-corrosion molded synthetic. Axles shall be hexagonal (round not acceptable) to provide positive locking connection to blades and linkage. Linkage shall be concealed out of the airstream, within frame to reduce pressure drop, noise and maintenance.
4. Damper shall be tested and licensed in accordance with AMCA 511 for Air Performance and Air Leakage. Dampers shall meet the requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A. Dampers shall be Ruskin Model CD50.
5. Outside and exhaust air dampers shall be parallel blade type with a two-position operator. Operators shall spring return closed on a loss of power.

10. Factory Supplied Control/Wiring

1. Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.
2. Provide factory mounted airflow measuring device as scheduled on drawings. Devices shall measure airflow via pressure differential. Devices utilizing standard pitot and thermal technologies are not acceptable. All devices must have an accuracy of +/-5% for the given application.
3. Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

4. Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.

2.4 UNITARY EQUIPMENT

A. Variable Refrigerant Flow Heat Pump System(Alternate Bid):

1. System Description:

a. The variable capacity, heat pump heat recovery air conditioning system shall be a MITSUBISHI ELECTRIC CITY MULTI VRFZ (Variable Refrigerant Flow Zoning), NO SUBSTITUTIONS. The systems shall be the R2-Series (simultaneous cooling and heating) split system heat pump.

b. The system shall consist of outdoor unit, Branch Circuit (BC) Controller, multiple indoor units, and Direct Digital Controls (DDC). Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

2. Quality Assurance:

a. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

b. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

c. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

d. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

3. Delivery, Storage and Handling: Unit shall be stored and handled according to the manufacturer's recommendation.

4. Warranty:

a. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year from date of Substantial Completion.

b. The systems must be:

(1) Installed by a contractor that has successfully completed the Mitsubishi Electric three day service course, AND

(2) Verified with a completed commissioning report submitted to and approved by the Mitsubishi Electric Service Department,

then the units shall be covered by an extended manufacturer's limited warranty for a period of five (5) years from date of Substantial Completion.

c. In addition the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of Substantial Completion.
d. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.
e. The extended warranty past the first year shall not include labor.

5. Manufacturer shall have a minimum of twenty-nine continuous years of HVAC experience in the U.S. Market.
6. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.
7. The system shall be installed by a contractor with extensive CITY MULTI installation and service training. The mandatory contractor service and installation training shall be performed by the manufacturer.

B. Water Source Unit: The WR2-Series PQRY water-source unit shall be used specifically with CITY MULTI VRF components. The WR2-Series shall consist of the PQRY water-source unit, Branch Circuit (BC) Controller, indoor units, and M-NET DDC (Direct Digital Controls). The PQRY water-source units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. The water-source unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

1. The water source units shall have a sound rating no higher than 51 dB(A) individually or 54 dB(A) twinned.

2. All refrigerant lines from the water-source unit to the BC (Branch Circuit) Controller(s) and from the BC Controllers to the indoor unit(s) shall be individually insulated. Insulation shall be a minimum ½" wall thickness with a thermal conductivity no less than 0.27 BTU-in/hr sq.ft °F. Refer to Specification Section 230700 for additional information.

3. The water-source unit shall have an accumulator with refrigerant level sensors and controls.

4. The water-source unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

5. The water-source unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.

6. The water-source unit shall have a freeze protection sensor to shut the unit off in the event of water flow failure.

7. The water-source unit shall have the ability to operate with a maximum height difference of 164 feet and have total refrigerant tubing length of 1,804 – 2,461 feet depending on the unit distance from the BC controller.

   The greatest length is not to exceed 541 feet between water-source unit and the indoor units.

8. The water-source unit shall be capable of continuous operation in heating or cooling mode with entering supply water temperature range between 23°F and 113°F without bypass valving.

9. Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Unit cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models.

10. Fan:

    a. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. external static pressure, but capable of normal operation under a maximum of 0.24 in. external static pressure via dipswitch.
    b. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
    c. All fan motors shall be mounted for quiet operation.
    d. All fans shall be provided with a raised guard to prevent contact with moving parts.
    e. The outdoor unit shall have vertical discharge airflow.

11. Coil:

    a. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
    b. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
    c. The coil shall be protected with an integral metal guard.
    d. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
    e. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

12. Compressor:

    a. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.
    b. A crankcase heater(s) shall be factory mounted on the compressor(s).
    c. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.

d. The compressor will be equipped with an internal thermal overload.
e. The compressor shall be mounted to avoid the transmission of vibration.
f. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

13. Electrical:

a. The outdoor unit shall be controlled by integral microprocessors.
b. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

C. Branch Circuit (BC-1) Controller:

1. General: The BC (Branch Circuit) Controllers shall include multiple branches to allow simultaneous heating and cooling by allowing either hot gas refrigerant to flow to indoor unit(s) for heating or subcooled liquid refrigerant to flow to indoor unit(s) for cooling. Refrigerant used for cooling must always be subcooled for optimal indoor unit LEV performance; alternate branch devices with no subcooling risk bubbles in liquid supplied to LEV and are not allowed.

2. The Branch Circuit (BC) Controllers shall be used with R410A systems. These units shall be equipped with a circuit board that interfaces to the controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

3. BC Unit Cabinet:

a. The casing shall be fabricated of galvanized steel.
b. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
c. The unit shall house two tube-in-tube heat exchangers.

4. Refrigerant: R410A refrigerant shall be required.

5. Refrigerant valves:

a. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
b. Each branch shall have multiple two-position valves to control refrigerant flow.

c. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
d. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

6. Integral Drain Pan: An integral condensate pan and drain shall be provided.

7. Electrical:

a. The BC Controller shall be controlled by integral microprocessors.
b. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

D. 4-Way Ceiling-Recessed Cassette with Grille Indoor Unit :

1. General: The unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

2. Unit Cabinet:

a. The cabinet shall be space-saving ceiling-recessed cassette.
b. The cabinet panel shall have provisions for a field installed filtered outside air intake.
c. Branch ducting shall be allowed from cabinet.
d. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
e. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space.

3. Fan:

a. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
c. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
d. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

e. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
f. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
g. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
h. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.

4. Filter: Return air shall be filtered by means of a long-life washable filter.

5. Coil:

a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
b. The tubing shall have inner grooves for high efficiency heat exchange.
c. All tube joints shall be brazed with phos-copper or silver alloy.
d. The coils shall be pressure tested at the factory.
e. A condensate pan and drain shall be provided under the coil.
f. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
g. Both refrigerant lines to the indoor units shall be insulated.

6. Controls: This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

E. Ceiling-Concealed Ducted Indoor Unit Pumps:

1. General: The unit shall be a ceiling concealed ducted indoor fan coil that mounts above the ceiling with a fixed rear return and a horizontal discharge supply, and shall have a modulating linear expansion device. The unit shall be used with the R2-Series outdoor unit and BC Controller. The unit shall support individual control using DDC controllers. The unit shall feature external static pressure settings up 0.80 in.
2. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
3. Unit Cabinet: The cabinet shall be ceiling-concealed, ducted.

4. Fan:

   a. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
   b. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
   c. The indoor unit shall have a ducted air outlet system and ducted return air system.

5. Coil:

   a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
   b. The tubing shall have inner grooves for high efficiency heat exchange.
   c. All tube joints shall be brazed with phos-copper or silver alloy.
   d. The coils shall be pressure tested at the factory.
   e. A condensate pan and drain shall be provided under the coil.
   f. The condensate shall be drained with an intergral condensate lift mechanism.
   g. Both refrigerant lines to the indoor units shall be insulated.

6. Controls: This unit shall use controls provided by MITSUBISHI ELECTRIC to perform functions necessary to operate the system.

F. Controls:

1. General: The CITY MULTI Controls Network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to existing Building Management Systems via BACnet®.

2. Electrical Characteristics:

   a. General: The controls network shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.

   b. Wiring:

      (1) Control wiring shall be installed in a system daisy chain configuration from indoor unit to remote controller to indoor unit, to the BC controller, to the Energy Recovery Ventilators (OAU) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
      (2) Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.

c. Wiring Type and Color:

(1) Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the system schematic drawings.
(2) Network wiring shall be CAT-5e with RJ-45 connection.
(3) Entire network and controls wiring color shall be Green.

3. Controls Network:

a. The Controls Network consists of remote controllers, schedule timers, system controllers, centralized controllers, and integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interfaces.

b. Simple MA Remote Controller:

(1) The Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The Simple MA Remote Controller shall be compact in size, approximately 3"x 5" and have limited user functionality. The Simple MA supports temperature display selection of Fahrenheit or Celsius. The Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto, dry, and fan), temperature setting, and fan speed setting. The Simple MA Remote Controller shall be able to limit the set temperature range from the Simple MA. The room temperature shall be sensed at either the Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.
(2) The Simple MA Remote Controller shall require no addressing. The Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to connection terminal on the indoor unit. The unit shall require cross-over wiring for grouping across indoor units.

c. System Group Controller: The System Centralized Controller shall be capable of controlling a maximum of 50 groups or a maximum of 50 indoor units across multiple outdoor units. The System Group Controller shall be approximately 5"x 5" in size and shall be powered using either the Power Supply on TB 7 of the outdoor unit or via the indoor transmission line on TB 3 on the outdoor unit. The System Group Controller shall have operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This control set of operation controls for the System Group Controller shall include on/off, operation mode selection (cool, heat, auto, dry, and

fan), and temperature setting. The System Group Controller shall be able to enable or disable operation of local remote controllers.

d. Centralized Controller:

(1) The Centralized Controller shall be capable of controlling via a PC a maximum of 50 indoor units across outdoor units. A field supplied PC shall be required for the Centralized Controller. The Centralized Controller shall be approximately 5"x11" in size and shall be powered from a Power Supply Unit. The Centralized Controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The Centralized Controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the Centralized Controller shall include on/off, operation mode selection (cool, heat, auto, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. Since the controller provides centralized control it shall be able to enable or disable operation of local remote controllers via the PC. In terms of scheduling, the Centralized Controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.

(2) Standard software functions shall allow the building manager to securely log into each controller via the PC's web browser to support operation monitoring, scheduling, error email, and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions shall be available of personal browser for PCs. Tenant Billing that requires TG-2000 Integrated System software in conjunction with Centralized Controllers. BACnet® interface shall be available through software operating on a dedicated PC and a controller license.

4. Web-based User Interface:

a. Licenses per function shall be required.
b. All PCs shall be field supplied.
c. PC-Monitoring: The communication network shall be capable of monitoring and operating all indoor units from a networked PC's web browser for up to 50 units per centralized controller.

5. PC Scheduling:

a. The communication network shall be capable of creating customized daily, weekly, and annual schedules from a network PC's web browser for up to 50 units per centralized controller.

Schedules shall be applied to a single indoor unit, a group of indoor units, or collectively (batch) to all indoor units controlled by the centralized controller.

6. Online Error Email: The communication network shall be capable of sending detailed alerts to customizable distribution lists based on user defined error types.
7. Personal Web Browser: The communication network shall be capable of allowing up to 50 individual users to monitor and control user defined zones via a network PC web browser.
8. Online Maintenance Diagnostics: The communication network shall be capable of performing maintenance diagnostics via a network PC and centralized controller using Maintenance Tool Software.

G. Communication Network: System Integration:

1. The communication network shall be capable of supporting integration with existing Building Management Systems (BMS) via BACnet® interfaces.
2. BACnet® Interface: The Mitsubishi Electric HVAC BACnet® interface shall be compliant with BACnet®/IP (ANSI/ASHRAE 135-1995, 135a) and UDP/IP of Ethernet (ANSI/ASHRAE 135-1995, 135b). The BACnet® interface shall require a dedicated network computer and activated BACnet® software function via Mitsubishi Electric HVAC issued license. The BACnet® software license shall be on for a maximum of 50 indoor units controlled by one Centralized Controller. The BACnet® interface shall support a maximum of ten Centralized Controllers for a maximum of 500 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.
3. Power Supply: The power supply shall supply 12VDC (TB 3) for the G-50 centralized controller and 24VDC (TB 2) voltage for the central control transmission.

2.5 TERMINAL EQUIPMENT

A. Water Source Heat Pumps (Base Bid):

1. Furnish and install water source heat pump of size, type, and capacity indicated. Unit shall be as manufactured by FLORIDA HEAT PUMP, BOSCH, CARRIER or McQUAY. NO SUBSTITUTIONS.
2. Units shall be designed to operate throughout the range of entering fluid temperature of 50°F to 110°F in the cooling mode and 50°F to 80°F in the heating mode.
3. Basic Construction: Units shall have the air flow arrangement as shown on the plans.
   a. All units shall have stainless steel drain pans to comply with this project's IAQ requirements. No exceptions shall be allowed.
   b. All water source heat pumps shall be fabricated sheet metal finished with Galvalume® plus, an aluminum-zinc alloy with a clear acrylic coating for additional corrosion protection sheet metal. All interior surfaces shall be lined with 1/2 inch thick, multi density acoustic

insulation. Insulation within the air handling section shall be foil faced. All insulation must meet NFPA 90A and be certified to meet the GREENGUARD Indoor Air Quality Standard for Low Emitting Products. One blower access panel and two compressor compartment access panels shall be removable with supply and return air ductwork in place.

c. All units shall have a factory installed four sided filter rack capable of accepting one inch filters for use with standard filter sizes. Units shall have a 1 inch thick throwaway type glass fiber filter as standard. The filter rack shall incorporate a 1 inch duct flange.

d. Cabinets shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be brass FPT fittings and shall be securely mounted flush to the cabinet allowing for connection to a flexible hose without the use of a back-up wrench. Water connections which protrude through the cabinet shall not be allowed.

e. Hanging brackets and condensate overflow switches shall be provided.

f. Fan and Motor Assembly: Units shall have a direct-drive centrifugal fan. The fan motor shall be a factory pre-programmed ultra efficient direct-drive ECM for maximum efficiency and quiet operation. Air flow shall be field adjustable.The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. External static pressure rating of the unit shall be based on a wet coil.

4. Refrigerant Circuit: Units shall use R-410A refrigerant

a. Hermetic compressor: Hermetic rotary, or scroll compressors shall be specifically designed for R-410A refrigerant and shall be internally sprung, externally isolated (rotary), with thermal overload protection and shall be located in an insulated compartment to minimize sound transmission.

b. Finned tube refrigerant to air heat exchanger not exceeding 14 fins per inch. Refrigerant to air heat exchangers shall utilize enhanced aluminum fins and rifled copper tube construction rated to withstand 600 PSIG refrigerant working pressure. All air coils shall have non-ferrous aluminum end plates.

c. Reversing valve. Reversing valves shall be four-way solenoid activated refrigerant valves which shall fail to the heating operation should the solenoid fail to function.

d. Coaxial (tube in tube) refrigerant to water heat exchanger. Refrigerant to water heat exchangers shall be of copper inner water tube and steel outer refrigerant tube design rated to withstand 600 PSIG working refrigerant pressure and 400 PSIG working water pressure.

e. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service.

f. Condensate overflow protection: A condensate sensor shall activate the lockout circuit upon sensing a high level of condensate in the drain pan and immediately put the unit into a hard lockout.

B, Electric Cabinet Unit Heaters (CUH-A):

1. Units shall be size, type, and have capacity as indicated. Provide units manufactured byMARKEL, TRANE, or approved equal.
2. Cabinet units shall be complete, including heavy gauge painted steel cabinet, electric heating element, fan, and motor. Units shall be of the configuration as shown on drawings. Provide thermal overload cutoff safety. Provide with built-in and factory-wired disconnect switch plus fan-speed switch. Color of cabinets to be selected by the Architect.
3. Units shall be UL Listed, and the heating element shall be provided with a manufacturer's 5-year warranty.
4. Wall temperature sensors for ceiling mounted units shall be provided under Section 230900.

C. Electric Wall Heaters (EWH-A):

1. Units shall be size, type, and have capacity as indicated. Provide units manufactured by MARKEL, TRANE, or approved equal.
2. Cabinet: The cabinet shall be constructed of heavy-duty 16-gauge zinc-coated steel. The cabinet shall be finished with a durable powder coated beige paint. The front cover shall be removable for easy installation and service of all internal components. The cabinet shall be designed for wall mounting.
3. Elements: Elements shall be all steel tubes with highest quality nickel-chromium resistance wire embedded in compacted efficient dielectric to ensure proper heat transfer. Steel helical fins shall be machine crimped and brazed to tube for effective transfer of heat.
4. Motor and Blower Assembly: Motor and blower shall be direct drive and resiliently mounted on a rigid heavy-gauge steel frame for quiet operation and long life. All motors shall have built-in overload protection and shall be lifetime lubricated.
5. Limit Controls: The heater shall utilize two safety limits built into the controls to automatically shut off the heater if safe operating temperatures are exceeded. The primary limit shall be a capillary type, which senses the heat along the full length of the elements. The secondary limit shall be a manual reset thermal device. All heaters shall have a built-in fan purge to dissipate residual heat from elements on heater shutdown.
6. Controls: Heater shall have integral thermostat. These controls shall be factory wired and adjustable through front cover.

D. Exhaust Fans (EF-1):

1. Fans shall be size, type, and have capacity as indicated on drawings. GREENHECK, LOREN COOK, or approved equal.
2. Downblast power roof ventilators shall have aluminum housing, backward-inclined aluminum fan wheel, gravity-type back-draft

dampers, bird screen, aluminum curb cap with pre-punched mounting holes, aluminum rub ring, motor isolated shock mounts, corrosion-resistant fasteners, lifting lugs and factory-wired NEMA 1 toggle disconnect switch. Provide direct or belt drive as indicated. Shaft shall be mounted in ball bearing pillow blocks. Bearings shall have grease fittings. Provide adjustable pulley and motor plate on belt drive units.

3. Fans shall be licensed to bear the AMCA Air and Sound Certified Ratings Seal. Fan air performance ratings shall be based on tests conducted in an AMCA registered laboratory for AMCA 210 air performance testing. The Test Standard used shall be ANSI/AMCA Standard 210-85, ANSI/ASHRAE Standard 51-1985, "Laboratory Methods of Testing Fans for Rating." All sizes must be tested, calculations to other sizes not acceptable. Fan sound performance shall be based on tests conducted in an AMCA registered laboratory for AMCA 300 Sound Performance Testing. The Test Standard used shall be AMCA 300 "Reverberant Room Method for Sound Testing of Fans." All sizes must be tested, calculations to other sizes are not acceptable. Air or Sound Test results are to be included in submittal.
4. Provide solid-state speed controls for all direct drive fans.
5. All fans shall be statically and dynamically balanced.
6. Install as required for quiet operation.

2.6 HVAC PIPING AND SPECIALTIES

A. Piping:

1. All condenser water/geothermal piping located in the main mechanical room shall be fabricated using welding steel or soldered copper fittings as indicated below. Use of polyethylene piping shall be limitied as detailed on the drawings. Transition fittings between steel and polyethylene piping shall be as specified in section 232113 Geo-thermal Piping Systems.

2. Condenser water (geothermal) piping 2-1/2 inches and larger shall be fabricated of Schedule 40 black steel, welded using Schedule 40 steel welding fittings. Pipe 2-inches and smaller shall be Schedule 40 black steel, screw fabricated using threaded malleable-iron fittings or shall be Type L copper, solder fabricated with wrought-copper soldering fittings using 95-5 solder.

3. Condensate drain piping within building shall be Type L copper tubing assembled with wrought-copper soldering fittings using 95-5 solder. Condensate drain piping on roof shall be Schedule 40 PVC pipe and fittings.

4. Refrigerant piping for variable refrigerant flow systems shall be ACR tubing assembled with wrought-copper brazed fittings using silver solder.

5. Gas Piping: Gas piping above ground 1/2" through 2" shall be Schedule 40 steel screw fabricated using malleable-iron fittings Gas piping and fittings exposed to weather shall be Schedule 40 galvanized steel.. Provide shut-off valves on gas mains, risers, and branches where indicated and at

connection to all gas-burning equipment. Provide gas regulators of size and pressure requirements noted.

6. Piping shall be run concealed, except where no ceiling is provided by the Architect. Coordinate installation of piping with other disciplines. Locate all piping tight against structure where possible. No piping shall be installed below mechanical equipment, or within mechanical equipment clearance requirements.

7. Pitch water piping to vent at high points and provide accessible drains at low points.

B. Geo Exchange Header

1. Manifolds:

a. High-density polyethylene (HDPE) pipe and fittings, joined together with heat fusion, shall be used for all of the circuit piping below grade. Transition to Schedule 40 black steel, welded using Schedule 40 steel welding fittings at slab penetration.
b. Circuit pipe 2-inches and smaller shall be Schedule 40 black steel, screw fabricated using threaded malleable-iron fittings or shall be Type L copper, solder fabricated with wrought-copper soldering fittings using 95-5 solder in the mechanical room.
c. All HDPE pipe and heat fused materials shall be manufactured from high-density, high molecular weight PE 3408 polyethylene compound that meets or exceeds ASTM D3350 cell classification 345464C, and is listed by the Plastic Pipe Institute in PPI TR-4 with HDB ratings of 1600 psi at 73°F and 800 psi at 140°F.
d. Pressure/temperature ports shall be brass and have a dual seal core of Nordel, good up to 350°F for water and shall be rated zero leakage from vacuum to 1,000 psig. Plug shall be capable of receiving a 1/8" pressure or temperature probe.
e. Isolation Ball Valves: All circuits shall include ball valves on supply for isolation. Valve shall be constructed of two-piece bronze body, 316 stainless-steel trim, blowout-proof stem, plastic-coated stainless-steel extended handle, stainless-steel handle nut, 316 stainless-steel vented ball, 316 stainless-steel extended stems sufficient to clear insulation, rated at 600 psi nonshock cold water pressure and 205 psi saturated steam. NIBCO model T-585-70-66-EL, or approved equal.

2. Venturi Flow Measuring and Balancing Valves:

a. All circuits shall include a venturi flow measuring and balancing valve on returns for balancing and isolation. Balancing valves shall be constructed of bronze or brass. Valves shall be rated for 400 psi at 250°F. Valves shall be provided with pressure/temperature ports and handle. Valves shall be equipped with metal tag and chain identifying circuit number. Valves shall be provided with extended stems sufficient to clear insulation. Valves shall be sized as recommended by valve manufacturer for intended flow capacity. TACO Model ACUF-300-F flanged., or approved equal.

b. Provide a portable master meter with carrying case as recommended by the balancing device manufacturer. Meter shall be scaled such that readings fall in the 25 to 75% range of full scale. Meter shall be rated for 500 psi working pressure, be complete with hoses which mate to furnished balancing devices. Meter to be 6" diameter face, 270-degree arc scale, beryllium diaphragm style gage with over-range protection and provided with GPM direct reading faces. Turn meter and tools over to Owner with letter of transmittal after water balance is complete

C. Valves:

1. Valves 2" size and under shall be bronze with soldered ends, rough bodies, and finish trim. Valves 2-1/2" size and over shall be iron-body, bronze-mounted with flanged ends, except where specifically indicated. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. Catalog numbers indicated below are NIBCO. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.

Size	Pipe Material	Globe	Check	Ball/Butterfly
2" and under	Copper	S-235	S-413-Y	S-585-70-66NS
2-1/2" and over	Copper	F718-B	F918-B	LC-2000
2-1/2" and over	Steel	F718-B	F918-B	LC-2000

2. Check valves in pump discharge lines shall be NIBCO F-910 “silent check valve”. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.

3. Balancing valves 2" and smaller shall be NIBCO S-585-70-66NS. Balancing valves 2-1/2" and larger shall be butterfly valves as specified below. Valves shall be complete with memory stops. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.

4. Butterfly valves used for balancing purposes shall be cast iron, lug type and suitable for dead-end service, 200 psig, bubble-tight shutoff, and 250°F service. Disc shall be aluminum bronze with 416 stainless-steel extended shaft and copper or brass bushings. Seat shall be EPDM. Provide lever actuators with ten positions with memory stops. Valves on cold or chilled piping shall have extended shafts to match the pipe insulation thickness to prevent condensation. NIBCO LC-2000, or approved equal. Valves 6" and above shall be provided with gear operators. Valves with equivalent characteristics by APOLLO, or MILWAUKEE are acceptable.

5. Pressure Relief Valves:

    a. Provide ASME-rated bronze body, direct spring-loaded, diaphragm-type, lever-operated relief valve with factory-set discharge pressure. Valve body shall have threaded connections and be designed for a working pressure of 150 psi. Fluid shall not discharge into spring chamber.
    b. Provide relief valves on low pressure side of pressure reducing valves where indicated.
    c. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity.

D. Circulating Pumps -Vertical Inline Series 80

1. Pumps shall be size, type, have capacity and arrangement as indicated, designed for service encountered. BELL & GOSSETT, or equal by TACO, WILO or PATTERSON.

2. Vertical inline pump Pumps shall be split-coupled in-line, single-stage design, for installation in a vertical position motor up, capable of being serviced without disturbing piping connections.

    a. Pump volute shall be of Class 30 cast iron. It shall be designed with abase ring matching an ANSI 125# flange for pump support. The impeller shall be of cast bronze, enclosed type, balanced to Hydraulic Institute Standards (ANSI/HI 9.6.4.5-2000, figure 9.6.4.15B). The allowable residual imbalance shall conform to ANSI grade 6.3, keyed to the stainless steel shaft and secured by a locking capscrew. The pump shaft shall be guided by a carbon graphite lower throttle bushing.
    b. The combination motor bracket and volute coverplate shall be a one-piece unit to ensure concentric alignment of the motor to the pump casing.
    c. The liquid cavity shall have a tapped flush line with manual valve to remove air from the seal chamber for fast initial start-up. The mechanical seal shall have a compact Rotating Unitized Seal Head design with EPR elastomer bellows and a positive metal-to-metal drive system to reduce the torsional stress on the bellows. The bellows will be pressure supported without creases or folds for long life.
    d. The spacer coupling shall be of high tensile aluminum, split to allow the servicing of the seal without disturbing the pump or motor. The motor bracket shall contain a carbon steel coupler guard conforming to both ANSI B15.1-2000 and OSHA 1910.219 standards for safety.
    e. Pumps shall be rated for continuous operation at a minimum of 175 psi working pressure and 250°F. The volute shall have gauge tappings at the suction, and discharge nozzles and vent and drain tappings at the top and bottom.
    f. Motor shall be energy efficient EPACT complying to NEMA or IEC

specifications and shall be the size, voltage and enclosure called for on the plans. It shall have heavy-duty grease-lubricated ball bearings, completely adequate for the maximum load for which the pump is designed.

g. Each pump shall be factory tested per Hydraulic Institute standards. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

E. Y-Strainers:

1. Strainers shall be self-cleaning "Y" type, of same size as pipe in which it is installed.
2. Provide valved blow-off outlet with hose connection and cap on each strainer. Blow-off connections shall be at bottom of strainer and shall be of size equal to ½ the pipe up to a maximum of 2".
3. Screen perforations shall be suitable for intended service. Provide mic ron screen for flushing of system.

F. Expansion Tanks

1. Tanks shall be ASME Code construction for 125 psi service, of sizes indicated. Tanks shall be pre-charged bladder type. BELL & GOSSETT Series "B-LA," or equal by TACO.

   a. Expansion tanks are ASME rated pre-charged bladder-type pressure vessels designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions.
   b. Tank shall have a heavy-duty bladder to contain system water to prevent tank corrosion and water logging problems.
   c. Maximum working pressure shall be 125 PSI and maximum operating temperature shall be 240ºF.
   d. System connections shall be forged steel. Tank shell shall be carbon steel
   e. Bladder shall be heavy duty butyl rubber
   f. Tank shall be designed and constructed per ASME Section VIII, Division.
   g. Tanks shall be complete with system and drain connections, air charging valve connection, and lifting ring.
   h. Volume of tank indicated is acceptance volume.

G. Pressure Relief And Reducing Valves

1. Provide relief and reducing valves with fast fill feature. Construction shall be cast iron with brass seats and brass strainer. BELL & GOSSETT, or approved equal.

`H. Air Eliminator And Dirt Separator:

1. Furnish and install a coalescing type air eliminator and dirt separator on the chilled water system, SPIROVENT Model VDN or equal. All combination units shall be fabricated steel, rated for 150 psig working

pressure with entering velocities not to exceed 4 feet per second at specified GPM.

2. Units shall include an internal bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle must consist of a copper core tube with continuous wound copper medium permanently affixed to the core.
3. A separate copper medium is to be wound completely around and permanently affixed to the internal element. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation.
4. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.
5. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
6. Separator shall have the vessel extended below the pipe connections an equal distance for dirt separation.
7. Air Eliminators shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid. Dirt separation shall be at least 80% of all particles 30 micron and larger within 100 passes.
8. Separator shall include a removable lower head to facilitate removal of assembly for inspection or cleaning.

I. Air Vents:

1. Provide manual air vents where indicated, and where required to properly and adequately vent heating system of air. Vent shall utilize a ball valve with handle in lieu of key operated.
2. Provide automatic air vents where indicated (in Mechanical Room only.) BELL & GOSSETT Model 107, or approved equal.

J. Thermometers

1. Thermometers shall be provided as indicated. WEKSLER INSTRUMENT, Type "AF."
2. Thermometers in pipelines shall be separable socket 5" dial bi-metal insertion type, with scale suitable for temperature range of medium being measured. Thermometers shall be located to facilitate reading from floor. Angle-type shall be used where necessary to facilitate reading. Install in thermal well in flow of fluid.
3. Thermometer range shall be 0-150°F for chilled water and 30-240°F for hot water.

K PRESSURE GAUGES

1. Pressure gages shall be provided on suction and discharge line of each pump and where indicated. WEKSLER INSTRUMENT, model AA-14-2.
2. Gages shall be bourdon spring type with 4-1/2" dial set in polypropylene case. Gauges shall be equipped with brass tee-handle shut-off cocks. Gauges shall have required range of 0-100 psig and not in more than 2 psi graduations.

L. Automatic Balancing Valves:

1. Provide NuTech Model AB, or approved equal, measuring and balancing valves where indicated for pipe sizes 1/2" to 12".
2. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5% of the specified amount.
3. For 1/2" - 2", the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for cartridge change out, inspection, and cleaning without breaking the main piping. (Access shall be similar to that provided for removal of a Y-strainer screen).
4. True operating range of 2 - 32 psid required. The design flow should be achieved at the minimum psi differential. A 50% safety factor applied to the lower operating range is not acceptable.
5. Each valve shall have two P/T ports.
6. All automatic flow control devices shall be supplied by a single source..
7. Five-year product warranty and free first year cartridge exchange.
8. The internal wear surfaces of the valve cartridge must be Ultrason® composite or stainless steel.
9. The flow cartridge design shall incorporate a stainless steel spring which requires no adjustment screw or shims. A crimped sheet-metal design is not acceptable.
11. The internal flow cartridge shall be permanently marked with the GPM.
12. For 1/2" through 2" pipe sizes: The valve shall consist of a brass Y-type body, O-ring-type union, and integral brass body ball valve with memory stop. The ball valve ID shall be minimum standard port (one size smaller than valve connection size) **Reduced port valves are not acceptable**. NuTech Model AB, or approved equal.
13. For 2-1/2" and larger flanged connections: Ductile-iron body suitable for mounting wafer style between standard 150# or 300# flanges. The long flange bolts and nuts shall be provided with each automatic flow control valve. NuTech Model AW or approved equal.
14. All valves shall be factory leak tested at 100 psi air under water.

15. Ratings: 1/2" through 2" pipe size: 600 PSIG at 250°F
    2-1/2" through 12" pipe size: 600 PSIG at 250°F

16. Where indicated on the plans, the differential pressure across the auto matic flow control valve shall be measured for flow verification and to determine the amount of system over-heading or under-pumping. Where over-heading exist the ball valve shall be throttled to bring the flow cartridge back within the control range. The valve memory stop shall be set so the valve can be used for isolation and reopened to the balanced position.
17. The flow shall be verified by measuring the differential pressure across the coil served or the wide-open temperature control valve and calculating the flow using the coil or valve C_v.
18. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2" diaphragm gauge equipped with 10-foot hoses and P/T adapters, all housed in a vinyl case. Calibration

shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.

19. Install automatic flow control valves on the return lines of coils as indicated on the plans. Balancing valve on supply side is not acceptable. Submit proposed piping arrangement for approval by the Engineer.
20. The standard ports and handles shall clear 1" thick insulation. Handle and port extensions are required for over 1" thick insulation.
21. Install, on the supply side of coils, a Y-strainer with a brass blow-down valve with 3/4" hose end connection with cap and chain.

M. Flow Stations:

1. Provide venturi flow meter and butterfly balancing valve as indicated. NUTECH Model MBF, or approved equal.
2. Flow meter sizes 2-1/2" thru 6" shall be constructed of cast carbon-steel ASTM A120 with accurately machined throat. Sizes 8" and larger shall be fabricated carbon-steel with carbon steel insert. Provide 150-pound ANSI B16.5 flanged connections. Meter shall be rated at 200 psig at 250°F. Provide brass needle valves 1/4" SAE M with 2.5" brass extension. Low loss venturi shall have a measurement accuracy of 3%.
3. Butterfly valve shall be constructed of ductile-iron, lug-type body, ANSI Class 125/150, with EPDM seat and gasket, 416 stainless-steel stem, Teflon bushing and aluminum/bronze disk. The butterfly valve shall have a 2" extended neck above the flange to accommodate insulation thickness. The valve handle shall have infinite flow positioning plate which allows the valve to be closed without the need of unlocking the valve handle or losing the balancing position on valve sizes 2-1/2" thru 6". Gear operator shall be supplied on valves sizes 8" and larger.
4. The entire assembly shall have been matched and laboratory tested for accuracy and shall have a 5-year warranty.
5. Total pressure drop shall not exceed one foot.
6. Provide a permanently installed differential pressure gage capable of directly measuring the flow rate in GPM. The gage shall have a 6" round dial protected by heavy-duty glass lens. Wall mount the gage remote from the meter as indicated.
7. Flow rate increments shall be suitable for the indicated flow rate.

N. Test Stations – Pressure/Temperature (PT):

1. Install a 1/4" NPT fitting (Test Plug) of solid brass with brass chain at indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1,000 psig. PETERSON EQUIPMENT COMPANY, SISCO, or approved equal.
2. One Master Test Kit shall be provided to the Owner. Kit shall contain one 2-1/2" pressure gage of suitable range, one Gage Adapter 1/8" o.d. probe, and one 5" stem pocket testing thermometer 0° to 220°F.

O. Hose Kits (Heat Pumps):

1. The units shall be connected with hoses. The hoses shall be 2 feet long, braided stainless steel; fire-rated hoses complete with adapters. Only fire-rated hoses will be accepted.
2. Manufacturers: NUTECH, FLOW DESIGN., or approved equal.
3. The inner tube shall be EPDM with a stainless-steel braided cover.
4. The assembly shall have brass swivel fittings on each end so the coil and balancing valve can be protected by short circuiting the coil during flushing.
5. All sizes shall be 400 psi working pressure rated, with a minimum burst pressure rating of 1,600 psi.
6. Each hose (100% of units shipped) shall be factory-proof pressure tested at 600 psi.
7. Fire rating not exceeding: Flame Spread – 25; Smoke Density – 50; Fuel Contribution – 0.
8. Conform to ASTM E84-80 and tested in accordance with ANSI 2.5; NFPA 255; UL 723; UBC 42-1; ASTM E84-75.
9. Each assembly shall have a 3-year warranty.

2.7 AIR DISTRIBUTION

A. Ductwork:

1. Provide all ducts, plenums, connections, dampers, and related items required to form a complete system as indicated on drawings and specified herein.
2. All ductwork shall be sheet metal.
3. Sheet-metal ducts shall be fabricated from G60 galvanized-steel sheets and shall be of gauges called for and as detailed in 2005 SMACNA Manual, HVAC Duct Construction Standards (Metal and Flexible). All supply and return ductwork shall be 1" w.g. pressure class construction and shall be single-wall rectangular or round.
4. Duct sealing requirements shall be Class B.
5. Duct shall be provided in continuous, un-joined lengths wherever possible. Except when interrupted by fittings, round spiral duct sections shall not be less than 12 feet long.
6. Round fittings may be spot welded and bonded.
7. Insulated-flexible air ducts shall be FLEXMASTER USA, or approved equal, suitable for indicated pressure classification and UL listed. Flexible ductwork shall be limited to maximum length of 5 feet and maximum velocity of 600 feet per minute. Contractor to provide proper flex duct size to ensure velocity limit is not exceeded. Support flexible ducts a minimum of every 4 feet. Supports shall not compress or constrict the flexible duct.
8. Provide flexible connections of fiberglass between ducts and air-handling unit connections. Details of construction and material shall be as per above-mentioned Manual, ASHRAE Handbooks, and as approved.
9. Space duct hangers every 4 feet, maximum. Insulated duct shall have saddle hangers. Hangers attached to the side of the ductwork are acceptable.
10. Fabricate ductwork with airtight joints, presenting smooth surface on inside, neatly finished on outside; construct with curves and bends to aid

in easy flow of air. Unless otherwise indicated, make inside radius of curves and bends at least width of ducts; where square elbows have to be used, provide fixed deflectors. Provide turning vanes in all low-velocity square elbows. Where fixed deflecting vanes are indicated, provide shop-fabricated blades, fit into side strips, and screw or rivet to duct elbow in field. Blades and side strips shall be small or large double vanes as detailed in SMACNA Duct Manual.

11. Construct, brace, and support ducts and air chambers in a manner that they will neither sag nor vibrate to any perceptible extent when fans are operating at maximum speed or capacity.
12. Install access doors as indicated, and where not indicated, in locations and of sizes which will afford easy access to multi-blade dampers, smoke detectors, fire dampers, and other equipment and devices requiring inspection and servicing. Access doors shall be installed to avoid lights, piping, conduit, ceiling grid, etc., to provide unobstructed access. Access doors shall be installed on the underside of the ductwork. Access doors shall be a minimum of 18" x 18" where possible. In non-accessible ceilings, provide access doors in ceiling.
13. Connect ductwork to dampers and other work installed in various trades requiring sheet-metal connections.
14. Make sheet-metal connections to masonry work airtight and watertight in approved manner.
15. Provide opposed-blade dampers for control of air volume and for balancing system, where indicated or required. Dampers shall be of sheet metal at least one gauge heavier than duct and reinforced; shall be installed in an accessible location. Provide indicating quadrant and locking device for adjusting and locking dampers in position. Provide extended shafts on all volume dampers greater than the thickness of the insulation to provide free movement of damper positioner. Stiffen duct at damper location, install damper in manner to prevent rattling.
16. Provide square to round transition fittings with balancing damper at all round-duct take-offs to supply diffusers and registers.
17. Provide access doors in building walls and ceilings where damper quadrants are concealed in shafts or above non-accessible ceilings.

18. Provide suitably constructed fire dampers where indicated and where required by NFPA 90A or by local ordinance or by Virginia State Fire Marshal.

    a. Fire dampers shall be fusible link actuated, constructed and installed per details in NFPA 90A, and shall be UL labeled. Fire dampers shall provide 100% free area with no restrictions in the airstream. Dampers shall be suitable for horizontal or vertical mountings.
    b. Fire dampers shall be dynamic curtain type or multi-blade type fusible link actuated, constructed and installed per details in NFPA 90A, and shall be UL 555 rated. Dampers shall be tested to close under airflow and rated for use in HVAC systems that are operational in the event of a fire emergency. Dampers shall be tested to all six UL 555 test configurations and shall be mounted either vertically or horizontally with airflow in either direction. Fire dampers shall provide 100% free area with no restrictions in the airstream. Dampers shall be constructed of galvanized or 304 stainless steel.

19. Duct sizes are inside free area. Increase duct sizes as required.
20. Ductwork and accessories shall not be delivered to the job site until just prior to erection and must be stored in an approved manner.
21. All ductwork shall be internally cleaned by vacuuming prior to installation.
22. All ductwork open ends shall be sealed with polyethylene and duct tape during construction after hanging.

B. Grilles, Registers and Diffusers:

1. Refer to drawings for types, material, models, finishes as manufactured by PRICE, TITUS, METALAIRE, NO SUBSTITUTIONS. Air devices shall have performance characteristics (throw, noise, and pressure drop) equal to air devices scheduled on the drawings. This information shall be provided with the submittal
2. Grille and register frames and louvers shall be one-piece construction.
3. Paint interior surfaces of ducts behind grilles and registers with flat black enamel.
4. Hinge-tab mechanism shall be provided to allow removal of 1" MERV-8 filter (Type 530FF).

2.8 VIBRATION ISOLATION

A. Vibration Isolators:

1. Mechanical equipment indicated below shall be isolated from the structure by resilient vibration and noise isolations. Equipment to be isolated includes, but is not limited to, rooftop ventilation units (RVUs), horizontal cabinet unit heaters, water source heat pumps, and VRF ducted indoor heat pump unit. Minimum deflection shall be 1".

a. Vibration Isolation System (RVUs):

(1) Rooftop units indicated shall be mounted on vibration isolation rails, and shall have sound barrier material installed throughout the area of the roof curb under the units. Rails shall be Model KSR-2 Isolation Rail System manufactured by KINETICS, or approved equal. System shall consist of two parallel aluminum rails with continuous neoprene air and water seal, incorporating steel spring isolators designed for 2" static deflection, all designed to be installed over the roof curb system furnished with each air-handling unit.

b. Horizontal cabinet unit heaters and ducted indoor heat pump units shall be suspended with vibration spring isolators, KINETICS Model ARS or approved equal.
c. Provide a minimum of three Type H vibration isolation hangers supports or guides for all ductwork connected to equipment that has been vibration isolated.
d. Deflection for hangers and supports shall be equal to that of isolated equipment but in no case greater than 1-1/2" nor less than 1/4".

e. Water Source Heat Pumps shall be suspended with vibration spring isolators, KINETICS Model SFH. Or approved equal.

B. Sound Isolation

1. RVU Acoustical Systems: Acoustical material inside the roof curb as shown on the drawings shall be furnished by the isolation curb manufacturer, and consist of the following:

a. Model RIM-RT shall consist of high-density, molded fiberglass pads individually coated with a flexible elastomeric membrane. Isolation pads shall be 2" thick and be spaced as recommended by the manufacturer but not greater than 16" centerline spacing. Pads shall be manufactured from annealed glass fibers stabilized by pre-compression during manufacture. Pads shall be designed to safely withstand a minimum imposed load of 200 psf in all open areas and shall have a minimum overload capacity of 100% in all high load areas.

b. 1-1/2" thick low-density, fiberglass absorption material shall be bonded to the isolation pads, and shall cover a minimum of 95% of the area between the isolation pads.

2.9 MEASUREMENT AND CONTROL

A. Description

1. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

2. Provide variable speed frequency drive (VFD) units for the following equipment:

3. P-1 and P-2

4. Manufacturers:

i. ASEA BROWN BOVERI
ii. DANFOSS GRAHAM
iii. TOSHIBA

5. Variable frequency Drives

a. The VFD package as specified herein shall be enclosed in a UL Listed Type 1 enclosure for indoor applications, completely assembled and tested by the manufacturer in an ISO9001 facility.
b. Environmental operating conditions: VFDs shall be capable of continuous operation at 32 to 120 F ambient temperature or VFD must be oversized to meet these temperature requirements.
c. Enclosure for indoor applications shall be rated UL Type 1, Type 12 for outdoor applications and shall be UL listed as a plenum rated VFD.

B. All VFDs shall have the following standard features:

1. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference
2. There shall be a built-in time clock in the VFD keypad.
3. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up.
4. The VFD shall have cooling fans that are designed for easy replacement.
5. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip.
6. 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. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
7. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients.
8. The input current rating of the VFD shall be no more than 3% greater than the output current rating.
9. The VFD shall include a coordinated AC transient surge protection system.
10. The VFD shall provide a programmable loss-of-load Form-C relay output.
11. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of mechanical failure / jam condition causing motor overload
12. 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.
13. If the input reference (4-20mA or 2-10V) 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.

C. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges.
2. Two (2) PID Set point controllers allowing pressure or flow signals to be connected to the VFD.
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 (ie. 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).
6. Six (6) programmable digital inputs for flexibility in interfacing with external devices.
7. Three (3) programmable, digital Form-C relay outputs.
8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control.
9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active.
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.
13. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
14. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD.
15. The VFD shall include password protection against parameter changes.

D. The Keypad shall include a backlit LCD display. All VFD faults shall be displayed in English words. The keypad shall include the following assistants:
   1. Start-up assistant
   2. Parameter assistants
   3. Maintenance assistant
   4. Troubleshooting assistant
   5. Drive optimizer assistants

E. 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:
   Output Frequency
   Motor Speed (RPM, %, or Engineering units)
   Motor Current
   Motor Torque
   Motor Power (kW)
   DC Bus Voltage
   Output Voltage

F. 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. 2) Operate in a specific fireman's override PID algorithm. The mode shall override all other inputs except customer defined safety run interlocks, and force the motor to run in one of the two modes above.

G. 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.
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 control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC 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 DDC 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 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 DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC 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 DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function.
6. The VFD shall include an independent PID loop for customer use.

H. EMI / RFI filters. All VFD's shall include EMI/RFI filters.

I. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring.

J. BYPASS CONTROLLER

1. A complete factory wired and tested bypass system shall be provided with the following operators:
   a. Bypass Hand-Off-Auto
   b. Drive mode selector
   c. Bypass mode selector
   d. Bypass fault reset
2. The bypass shall include a LCD display that allows the user to access owner requested data including but not limitied to fauls, bypass power (KW), and energy savings.
3. The following indicating lights (LED type) or keypad display indications shall be provided.

K. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

L. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current.

M. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified 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.

N. The VFD Product Warranty shall be 24 months from the date of ceritified start-up. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

PART 3 - EXECUTION

3.1 TESTS

A. The Owner shall be represented at all tests. Contractor shall provide 48 hours notice to the Owner prior to the tests.

B. Before insulation is installed and before piping is concealed, test water piping hydrostatically and prove tight under 100 psig pressure. Test pressure shall be held for minimum of 8 hours. An air test in lieu of water may be used when danger of freezing is possible and when approved.

C. Test all gas piping at 50 psig with oil-free compressed air for 2 hours with no loss of pressure.

D. Refer to Specification Section 230593, "Testing, Adjusting, and Balancing," for related requirements.

E. Variable Refrigerant Flow systems refrigerant piping shall be tested with dry nitrogen and trace of refrigerant at test pressures recommended by equipment manufacturer (600 psig minimum). After system has been proven tight under test pressure, it shall be evacuated to a pressure 2.5 mm Hg absolute. The refrigerant compressor shall not be used for evacuating the system. Vacuum shall be checked by use of a mercury manometer.

3.2 WATER TREATMENT

A. Prior to initial start up of mechanical system, Contractor shall thoroughly flush and clean system to remove sediment and debris from system. Contractor shall also provide the necessary flushing chemicals and water treatment chemicals required after system has been refilled as recommended by the water treatment specialist. The water treatment specialist shall provide written report of conditions found for review and verification by Owner

1. Prior to commencement of water treatment, including initial flushing of hydronic loop piping, submit qualifications of the water treatment specialist to the Engineer for review and approval. Include in the submittal a detailed schedule of the flushing and final water treatment procedure. Include all chemicals to be used for cleaning the hydronic systems during the flushing and cleaning process and the chemicals required to treat the water once the system is refilled and prior to system start up. The water treatment specialist shall calculate the volume of water required in each hydronic system and determine the required chemical treatment mixtures and how they will be applied. Submit calculations to the Engineer for review and approval. Contractor shall provide a minimum of 2 weeks' notice to the Architect, Engineer, and Owner's representative of scheduled cleaning, flushing and water treatment events.

2. Prior to connecting equipment to hydronic systems, all piping shall be flushed with a detergent mixture to remove previously accumulated dirt and other organic residue. Where equipment bypass piping is required by the drawings, isolate equipment from the loop and open bypass valves during flush. In old piping systems with heavy encrustation of inorganic materials, contractor shall consult the water treatment specialist for proper passivation and/or removal of these contaminants. All cleaning and flushing and final chemical treatment of hydronic systems shall be observed and directed by the contractor's water treatment specialist.

3. During the cleaning and flushing, a 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The flushing process shall take no less than 6 hours or until the strainers, when examined after each flushing, are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and until the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions and as recommended by the water treatment specialist. After flushing with the detergent and/or dilute acid concentrations, the system loop shall be

purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out. Flush water shall be disposed in accordance with all local, state, and federal regulations.

4. At the completion of the cleaning and flushing, a water test shall be performed by the water treatment specialist to establish that the pH of the refilled circulating water is below 8.0 pH or within 0.5 pH of the makeup water. In addition, the conductivity of the system should be within 10% of the makeup water. Add chemicals as recommended by the water treatment specialist as required to achieve the above results. Submit documentation of this test to the Engineer for review.

5. The appropriate manufacturer's service literature shall be made available to the Owner for guidelines concerning preventative maintenance.

END OF SECTION 230500

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING (TAB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 230100, "Mechanical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. The General Contractor shall obtain the services of an independent testing and balancing agency whose business is limited to testing, adjusting, and balancing and shall be certified by AABC (or NEBB). Agency shall have been in the TAB business for a minimum of 5 years. The TAB (Testing, Adjusting, and Balancing) Agency shall be a direct subcontractor of the General Contractor, and not affiliated in any way with the Mechanical Contractor.

B. Testing and balancing shall be performed in accordance with National Standards for Testing and Balancing Heating, Ventilating, and Air-conditioning Systems, 2002, as published by Associated Air Balance Council (AABC).

C. All work shall be performed under the direct supervision of a certified TAB Engineer. All other personnel shall be regular full-time employees of the TAB Agency.

D. Test and Balance Agency shall submit within 30 days after receipt of construction contract two copies of qualifications, including current TAB Engineer's certificate and National Project Certification Performance Guaranty.

E. TAB work shall not commence until all components of the HVAC system have been installed completely, including all power wiring and controls, and all equipment has been started and run tested in each mode of operation. Should any items be found incomplete at the time that TAB work is performed, the TAB Agency shall immediately notify the General Contractor and Owner's Representative of any deficiencies found. The General Contractor shall be responsible for correcting reported deficiencies and verifying that the system is 100% complete, operable, and ready for TAB work to proceed.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Provide all necessary instrumentation required to measure and adjust the HVAC air and water systems.

B. Equipment and instruments shall be of types approved by the Owner's Representative, and/or manufacturers of devices installed.

C. Instruments used for testing and balancing of air and hydronic systems shall have calibration verified within a period of 12 months prior to balancing.

PART 3 - EXECUTION

3.1 GENERAL, MECHANICAL, AND ELECTRICAL CONTRACTOR'S RESPONSIBILITY

A. The General Contractor shall be responsible for directing the Mechanical and Electrical Contractors to fulfill the Contractors' Responsibility for Testing, Adjusting, and Balancing as required in Section 230100. TAB work shall not commence until the conditions of paragraph 1.2.E of this Section and all requirements of Section 230100 for TAB have been completed.

3.2 TAB AGENCY'S RESPONSIBILITY

A. Carefully review the drawings and Specifications for the various systems noting all facilities incorporated in the design for purposes of adjusting and balancing. Should it be deemed necessary to provide additional dampers, baffles, valves, or other devices which would aid in the required adjusting and balancing, same shall be provided by the installing contractor.

B. The TAB Agency shall report any and all deficiencies that prohibit adjusting and balancing in accordance with the Contract Documents to the Contractor and the Owner's Representative.

C. Adjust all water piping, duct, and equipment, including valves, controls, dampers, cocks, etc., to properly perform to ±10% of their respective design quantities of flow.

D. Determination of the air volumes shall be made by pitot tube and differential draft gauge for all supply, return, outdoor air, and exhaust air ducts. Openings for pitot traverses shall be provided as required and shall be fitted with neat removable plugs or covers. Air quantities at grilles, registers, diffusers, etc., shall be measured as recommended by the various manufacturers of the outlets.

E. The Test and Balance Agency shall perform the following:

1. Adjust fan RPM, tighten and align fan belts, measure operating amps.
2. Adjust volume dampers to obtain designed air volume.
3. Adjust grilles, diffusers, and registers to obtain designed airflow and air pattern.
4. Set balancing valves to obtain designed water flow at units, coils, and branches.
5. Adjust each air handler to obtain designed airflow.
6. Adjust dampers to provide design outside air quantities.

7. In cooperation with the ATC Contractor's representative, setting adjustments of automatically controlled dampers to operate as specified. The TAB Agency shall inform ATC Contractor of all abnormalities in sequencing and/or calibration of components discovered during balancing.
8. Final settings of dampers and valves shall be permanently marked. Where provided, memory stops and locking devices shall be adjusted and locked to the final setting.
9. Assist Fire Alarm Contractor in the testing of all duct smoke detectors. Measure the air velocity across each duct smoke detector with air handling unit at full airflow.

F. Before the work is offered for Final Acceptance, all equipment shall be run through a test to demonstrate that it has been adjusted to meet the requirements of the drawings and Specifications. Copies of the test and adjustment data shall be submitted in a report to the Owner's Representative prior to final inspection.

G. The TAB Report shall include a General Comments section providing an overview of systems operation, observations of system installation abnormalities and deficiencies, problems encountered, etc. If required, provide explanation of methods of measurement and disparity between measured and design quantities.

H. Test and Balance Agency Report shall include the following data for each system. All sheets shall be neatly typed. Balancing Agency shall submit with his report a set of neatly marked plans identifying location of each piece of equipment, air terminal, flow measuring device, and points of traverse. Report all measured quantities and design quantities where applicable.

1. CFM of each supply, return, exhaust grille, and diffuser.
2. RPM and CFM of each fan.
3. Supply, return, and outdoor air CFM of each AHU and fan terminal unit where required.
4. Air pressure drop across A/C unit cooling coils.
5. Air pressure drop across each filter bank.
6. Discharge and suction static pressure of each fan.
7. Maximum and minimum differential pressure and corresponding CFM of each terminal box.
8. Voltage rating and operating volts of each fan motor. For fan motors requiring three-phase power, record voltage of each individual phased leg and check for voltage imbalance.

9. Temperatures and pressures for each chiller at maximum capacity, including the following:

    a. Entering and Leaving water temperature.
    b. Water pressure drop.

10. CFM of each exhaust hood.

11. Temperatures for each air handling unit at maximum capacity including the following measurements:

    a. Entering and Leaving air temperature at each coil.

b. Entering and Leaving water temperature at each coil.
c. Entering and Leaving air temperatures at each energy recovery wheel on supply and exhaust side of wheel.

12. Air Handling unit is defined as any equipment that consists of a fan and coil, including RVU-1 and heat pumps.

13. Temperatures for each heat exchanger device at maximum capacity, including the following:

a. Entering and Leaving water temperature.
b. Entering and Leaving air temperature.

14. Nameplate data of each piece of HVAC equipment installed.
15. GPM of each pump and corresponding suction and discharge pressure.
16. Voltage rating and operating volts of each pump motor. For pump motors requiring three-phase power, record voltage of each individual phased leg and check for voltage imbalance.
17. Amp rating and operating amps of each pump. For pump motors requiring three-phase power, record amps of each individual phase.
18. Differential pressure and corresponding GPM across each flow measuring device, including automatic flow control devices.
19. Final percent setting after adjustment of each balancing valve where applicable.
20. Velocity across each duct smoke detector at full airflow.

I. During the Final Inspection, the Agency shall have present all necessary instrumentation and an individual to make readings of select information which was submitted in the balance report. The select readings shall be made where directed by and in the presence of the Owner's Representative and shall not deviate more than 5% from the values submitted in the report.

J. The Owner's Representative may select no more than 20% of all reported data for rechecking. If more than 20% of data verified is not within ±5% of submitted data, the Owner's Representative may void entire report and ask for complete rebalancing. The field check shall be made within 45 days of approved TAB submittal.

END OF SECTION 230593

SECTION 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 230100 "Mechanical General Provisions," apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturers' data on all insulation products, schedule which indicates where each product is to be used, and thickness of each product.

1.3 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of materials and workmanship for a period of 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

A. All insulation shall have a composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke rating as requested by ASTM E84, NFPA 255, and UL 723, not exceeding:

Flame spread	25
Smoke developed	50

B. Accessories, such as adhesive, mastics, cements, tapes, and fire-resistant cloth for fittings, shall have same fire and smoke ratings as components listed above.

C. Installation of insulation shall be accomplished in strict accordance with manufacturer's recommendations and shall be CERTAINTEED, OWENS-CORNING, or JOHNS MANVILLE for glass fiber insulation; ARMACELL for flexible unicellular insulation.

2.2 PIPE INSULATION

A. Glass fiber insulation having a thermal conductivity not greater than 0.24 Btu x in./hr. x sq. ft. x °F in a mean temperature of 75°F. Insulation shall have factory-applied all-purpose jacket.

B. Flexible unicellular insulation having a thermal conductivity not greater than 0.27 Btu x in./hr. x sq. ft. x °F in a mean temperature of 75°F.

2.3 DUCT INSULATION

A. Blanket Type within the conditioned space: Glass fiber, ¾-lbs/cu. ft., foil faced, vapor-sealed flexible duct insulation. Thermal conductivity shall not exceed 0.29 Btu x in./hr. x sq. ft. x °F.

2.4 CALCIUM SILICATE PIPE INSULATION INSERTS

A. Calcium silicate meeting ASTM C533, Type I; rigid molded pipe; asbestos-free JOHNS MANVILLE Thermo-12/Gold, or approved equal.

B. Thermal conductivity of 0.45 Btu at 300°F mean temperature as tested in accordance with ASTM C335.

C. Minimum compressive strength of 100 psi to produce 5% compression at 1-1/2" thickness.

D. Non-combustible as determined by test complying with ASTM E136.

E. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation.

2.5 PVC PIPE JACKET FITTING COVERS

A. One-piece molded-type PVC plastic fitting covers and jacketing material, color matching JOHNS MANVILLE Zeston 2000, or approved equal.

B. Connections shall be made using pressure-sensitive color matching vinyl tape.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Insulation shall be installed by a licensed applicator and in strict accordance with the manufacturer's instructions. Deliver all materials to the job site and store in a safe, dry place. Use all means necessary at the job site to protect materials from dust, dirt, moisture, and physical abuse before and during installation. Insulation that becomes damaged prior to installation shall not be installed and shall be removed from the job site. Insulation that becomes damaged after installation shall be removed and disposed of and replaced with new insulation.

B. Surfaces to be insulated shall be cleaned free of dirt, scale, moisture, oil, and grease prior to installation of the insulation.

C. Insulation that becomes wet before or after installation shall be removed and disposed of and replaced with new insulation.

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3.2 PIPING (GLASS FIBER INSULATION, UNLESS OTHERWISE NOTED)

A. Schedule:

Condensate Drain:	1/2" thickness
Domestic Hot, Cold Hot Water Circulating:	1/2" thickness for pipe sizes up to 1-1/4", and 1" thickness for pipe sizes over 1-1/2".
Variable Refrigerant Flow Systems Refrigerant Gas	1/2" thickness flexible unicellular
Refrigerant Piping: (Ductless Split System)	1" thickness flexible unicellular
Geothermal Condenser Water:	1" thickness for pipe sizes up to 1-1/2", and 1-1/2" thickness for pipe sizes over 1-1/2".
Chemical Feed:	1/2" thickness
Heat Pump Flexible Hoses:	1" thickness flexible unicellular

B. Fittings and valves on insulated piping smaller than 4" shall be insulated with fiberglass blanket to thickness equal to adjoining pipe insulation unless otherwise noted. All fittings and valves, insulation shall be finished with a preformed PVC jacket.

C. All valves and piping accessories above ceilings handling cold and geothermal condenser water shall be completely insulated to prevent condensation.

D. Fittings and valves on refrigerant piping shall be insulated with cut sections of flexible unicellular insulation of thickness equal to adjoining pipe insulation.

E. No piping shall be insulated until it has been tested and thoroughly cleaned.

F. Provide pipe inserts between pipe hanger support shields and on piping 1-1/2" diameter or larger. Insulation inserts shall not be less in length than the following:

1-1/2" to 2-1/2" pipe size 10" long
3" to 6" pipe size 12" long

H. Hangers and supports for cold and geothermal condenser water piping shall not injure or pierce insulation.

3.3 DUCTWORK

A. Definitions:

1. Concealed: Ductwork which shall be hidden from view by ceilings, walls, chases, or soffits, either by the work of this Contract, or by future tenant build-out work.
2. Exposed: Ductwork which is permanently in view, typically found in mechanical, storage, electrical, or other unfinished space.

B. Schedule:

Concealed Supply, Return Ductwork Externally Insulated (inside the conditioned space)	2" thickness blanket
Transfer Ducts:	Not Required
Exhaust Ducts:	Not Required

C. Insulate necks and tops of all supply air diffusers, registers, and grilles.

D. Blanket-type insulation shall be stapled and taped in accordance with manufacturer's instructions.

E. Insulation on ductwork over 16" in height or width must be attached with stick pins. When using self-adhesive pins, prepare surface to be applied to ensure adhesion.

F. Tape all edges of insulation to ensure that no insulation is exposed.

3.4 COLD EQUIPMENT

A. Schedule:

Circulating Pumps:	2" thickness, flexible unicellular
Geothermal Water System Chemical Feeder:	1/2" thickness, flexible unicellular
System Expansion Tanks, Basket Strainer and Air Separator:	2" thickness, flexible unicellular

B. Install equipment thermal insulation products in accordance with manufacturer's written instructions and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

C. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

D. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.

E. Provide removable, insulated, galvanized steel box to cover parts of pumps and basket strainer which must be opened periodically for maintenance.

END OF SECTION 230700

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SECTION 230900 – AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including Division 1 Specification Section and Section 230500, "Mechanical General Provisions," apply to this section.

1.2 SUMMARY

A. Section includes control equipment and software.

1.3 REFERENCES

A. American National Standards Institute

1. ANSI MC85.1: Terminology for Automatic Control

1.4 SYSTEM DESCRIPTION

A. A fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control. Use of multiple manufacturers' products is not allowed.

B. A peer-to-peer network of DDC controllers and a Web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A Web server with a network interface card shall gather data from the system and generate Web pages accessible through a conventional Web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the Web browser interface.

C. A network system touch screen display shall reside on site for local system interface to control and monitor all system equipment.

D. Provide DDC controls for terminal units, unit heaters, and VRF Fan Coils.

E. Provide control system consisting of thermostats, dampers operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems and to perform functions specified.

F. Provide installation and calibration, supervision, adjustments and fine tuning necessary for complete and fully operational system.

1.5 SUBMITTALS

A. Refer to Specifications Section 013300 "Submittals".

B. Shop Drawings: Indicate the following:

1. Network riser diagrams showing programmable control unit locations and network data conductors.
2. Connected data points, including connected control unit and input-output device.
3. System graphics showing monitored systems, data (connected and calculated).
4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems and interconnections.
5. Description and sequence of operation for operating user.

C. Product data: Submit data for each system component and software module.

D. Manufacturer's installation instructions: Submit installation instruction for each control system component.

E. Manufacturer's certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Execution Requirements: Requirements for submittals.

1. Project Record Documents:

a. Record actual locations of control panels and components, including control units, thermostats and sensors.
b. Revise shop drawings to reflect actual installation and operating sequences.
c. Submit data specified in "Submittals" in final "Record Documents" form.

B. Operation and Maintenance data:

1. Submit interconnection wiring diagrams, complete field installed systems with identified and numbered, system components and devices.
2. Submit inspection period, cleaning methods, cleaning materials recommended and calibration tolerances.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of ten years global experience and with technology center within 120 miles of this project.

B. Installer: Company specializing in performing work of this section with a minimum five years documented HVAC experience, trained, certified and approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Refer to Specifications Section 013100: Project Management and Coordination: Pre-installation meetings.

1.9 RELATED WORK IN OTHER SECTIONS

A. Refer to Division 00 and Division 01 for related contractual requirements.

B. Refer to Division 23 for General Mechanical Provisions.

C. Refer to Division 26 for General Electrical Provisions.

1.10 WARRANTY

A. Execution Requirements: Requirements for warranties.

1. Installer shall provide a standard one year warranty on all control products and labor associated with this project.
2. Installer shall provide five year warranty on all motorized valves and damper operators.
3. Installer shall provide a three year warranty on all variable speed drives associated with this project.

1.11 SERVICE

A. Execution Requirements: Requirements for service.

B. Furnish service and maintenance of control systems for one year from date of substantial completion. Include complete service of control systems including callbacks. Make a minimum of two complete normal inspections of four hours duration in addition to normal service calls to inspect, calibrate and adjust controls.

C. Perform work without removing units from service during normal building occupied hours.

D. Provide emergency call back service at all hours for this maintenance period.

E. Maintain at local branch office, adequate levels of replacement parts in stock for emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without reasonable loss of time.

F. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

PART 2 PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

A. Acceptable manufacturers:
   1. Subject to compliance with requirements, provide products by the following manufacturer (NO SUBSTITUTUIONS):
      a. NOVAR CONTROL SYSTEMS

   2. Controllers:
      a. TREND

   3. Actuators:
      a. BELIMO
      b. HONEYWELL

   4. Sensors:
      a. ACI
      b. HONEYWELL
      c. JOHNSON
      d. KELE
      e. TREND
      f. VERIS

   5. Relays & Current Switches:
      a. FUNCTIONAL DEVICES

2.2 MATERIALS

A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

B. A single manufacturer shall to the greatest extent possible, manufacture system components.

2.3 COMMUNICATION

A. Control products, communication media, hubs, and routers shall comprise a unified control network. Acceptable network mediums are Cat 5 Ethernet or twisted pair networks. Controller products and hardware or software gateways shall be from a single manufacturer.

B. Use existing TCP/IP Ethernet backbone for network segments to all DDC Building Controller panels marked on project drawings. Project drawings indicate remote buildings or sites to be connected via intranet or Internet connections. In each remote location an intranet or Internet connection shall be provided for connection to the building automation system (BAS).

C. Connection to BAS shall be by connecting to any Ethernet port in the facility for temporary connection to a laptop computer or other operator interface such as a Pocket PC or system display panel. In addition, any workstation in the facilities may be used for Web browser communication to BAS system. Connection shall support commissioning and troubleshooting operations.

D. System shall automatically synchronize controller time clocks daily from an operator-designated controller via the network. If applicable, system shall automatically adjust for daylight saving and standard time.

E. System shall communicate in a peer-to-peer way and discretely check for system errors and verify controller communications.

2.4 OPERATOR INTERFACE

A. Monitoring, Displaying and Reporting of Energy Data:

1. The DDC System shall monitor Electricity at the main incoming service to the facility or as approved and shall display power consumption in KW hours, demand in KW and power factor based on previous day, previous week, previous month or previous year and should also allow for selecting the dates between which data needs to be viewed.
2. The DDC system shall monitor the Water meter, and shall display current consumption and cumulative consumption in Gallons based on previous day, previous week, previous month or previous year and should also allow for selecting the dates between which data needs to be viewed.
3. The DDC system shall monitor the Natural Gas meter, and shall display current consumption and cumulative consumption in MCF based on previous day, previous week, previous month or previous year and should also allow for selecting the dates between which data needs to be viewed.
4. All these parameters shall be displayed on an Energy Dashboard based on MS Silverlight. The dashboard will utilize the data from the DDC system and will be hosted locally. The dashboard should normalize electricity consumption based on degree days so as to show the true energy consumption. The dashboard should generate reports in MS Excel for all the data that is being displayed.

B. Operation. Graphical User Interface shall have full Client-Server capabilities. Server PC shall reside on the data network and be accessible from building intranet or Internet as specified by building owner by a standard Web browser.

1. No other software or data files will be required on client PCs other than a standard Web browser with Java enabled.
2. Server shall be able to connect to remote buildings via telephone modem links and via intranet or Internet across firewalls.
3. Only one Server PC shall be required in the event Owner wants to expand system to future facilities.
4. In the event of failure, the Server PC will not be required to run for normal operation of the DDC system.

C. Communication. Server PC and Building Controller network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer using TCP/IP protocol.

GUI software shall have the capability to connect to remote sites via intranet, Internet or over standard telephone lines without the need for supervisory software at remote sites.

D. BACnet Communication. GUI software to provide access to BACnet devices. GUI shall map BACnet devices in the system, enabling consistent supervision tasks between devices. GUI shall allow values from the BACnet devices to be included in schematic pages, and also enable users to make adjustments to and receive alarms from those devices.

E. Database Generation and Backup. The Graphical User Interface software shall have the capability to generate its database automatically and will self-learn on connection to the DDC system. This function will also apply if any future facilities are added to the DDC system. System databases should have the capability to be backed up on a regular basis to a specified location.

F. Graphical Functionality. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

1. Graphical file types supported should include BMP, GIF, JPEG, WMF and EMF files as a minimum.
2. The following files types must be able to be integrated into graphics pages: SWF, HTML, DOC, XLS, XML, PPT, PDF and URL as a minimum.
3. Graphics pages must be able to be organized into folders in a menu tree format for easy navigation between buildings and areas of buildings.
4. A full graphics library should be included showing typical mechanical components such as Boilers, Chillers and AHUs.
5. All dynamic data shown on the GUI must be in live format. Data shown from a database of parameters is not acceptable. All dynamic data points when clicked shall allow the operator to change setpoints and parameters or view data logs.
6. Data logs. Multi-trace color data logs should be able to be viewed in a single window or in text format. Zoom in-out features must be supported when viewing data logs. Charting of points or live data recording of values must also be supported.
7. Dynamic graphics must be capable of 3D color dynamic movement to indicate status of controlled plant and color shifts to represent temperatures in occupied zones.
8. Graphical buttons and icons shall provide access to other graphic pages or screens or command custom sequences or events or other custom screens.
9. GUI must support script commands to initiate automatic viewing of graphics pages or system commands from a button or icon.

G. Database functionality. The Graphical User Interface (GUI) software shall include Microsoft Data Engine (MSDE) databases and be capable of SQL commands and interrogation from enterprise level software applications. GUI shall also have a dedicated graphical database view of connected DDC systems connected in site, LAN and controller, similar to windows explorer style view of connected DDC systems. The

database viewer shall support viewing of all hardware IO and software points, changes to system parameters and schedules and viewing of data logs and active alarms should be accessible from this view. User filtering of inputs, outputs, setpoints and schedules must be provided allowing the operator to search database for point types or by point name.

H. Schedule management. It is not acceptable for the GUI to be the sole system scheduling device. Schedules and exceptions must reside at the controller level and be unaffected should the GUI be disabled for any reason. The GUI shall support the following scheduling features:

1. Allow users to manage multiple controller occupation times into groups in the following ways. By system, building, area of building or single occupied zone. GUI shall allow schedules to be added or removed from schedule groups.
2. Users should be able to implement holiday or other schedule exceptions to a Global, building, area of building or single occupied zone level.
3. A calendar display of all normal operating schedule times and exceptions shall be shown. Exceptions dates shall be shown in different color formats for ease of identification by user. Exception scheduling must be able to be carried out at least 20 years in advance as a minimum. Annual recurring exception dates should be implemented once only without the need for further user interaction.
4. Normal operating schedules should be shown in a graphical form in week format. Day operating times should have the ability to be copy and pasted for day, week or working week.
5. Schedule On-Off Periods. A minimum of 50 on-off periods per day must be available for selection.

I. Alarm monitoring. It is not acceptable for the GUI to be the sole system alarm monitor. Alarms must be generated at the controller level and reported alternatively should the GUI be disabled for any reason. Every system alarm at network, controller or device level, any user adjustment of the system or failure of a scheduled event shall be logged, time and date stamped in the alarm database. Alarm database will show active, active/acknowledged, cleared and cleared/acknowledged alarms. It shall be possible to view alarms in chronological or summary views. Alarms shall show time of occurrence, type of alarm, origin and explanation of alarm in text format. Alarms shall be delivered automatically to central GUI over intranet, Internet or phone lines. In addition, the GUI shall have the following features:

1. Alarms shall be filtered and grouped to enable specific alarm actions and retransmissions dependent on the type of alarm received.
2. Once an alarm has been initiated, an active alarm panel window shall be flashed on screen with an audible alert. Alarms shall be silenced and/or actioned from the alarm panel and specific graphic pages shall be shown dependent on alarm filter and group.

3. Once an alarm has been received at the GUI, the alarm shall be forwarded dependent on which alarm filter and group the alarm is associated with. Alarms shall be capable of being forwarded in the following methods without the need for additional software:

    a. As an email to any valid email address.

b. As a cell phone text message via the Internet.
c. As a cell phone text message via SMS directly from the GUI PC.
d. In SNMP format to existing network management software.
e. To any other DDC system alarm receiver such as a system display panel.
f. To an attached or network printer.

J. Event scheduling. Automated scheduled events shall be user configurable and all pending or past events shall be viewed in chronological format or be filtered by event type. In addition, all automated scheduled events shall have the capability of being manually initiated, edited or deleted at any time by the operator. Scheduled events shall include but not be limited to:

1. Data log recording upload to database.
2. Automated schedule download.
3. System time synchronization.
4. Automated database backup.
5. Automated printing of graphics pages.

K. Internet connectivity. GUI software shall allow for access to any intranet or Internet Web site or IP address to allow seamless integration to any Web-enabled equipment or systems such as access, lighting, fire and security systems. Web or IP addresses must have the ability to be saved and named for later use. GUI software shall allow for access to any building controllers configuration or programming mode via controllers Web interface.

L. GUI software shall have a multi-level security system. Each user shall have a unique username and password set up in the PC server and each user shall belong to a user workgroup that has identical access rights to all the functional areas of the GUI software. No access to the GUI shall be possible until a valid username and password has been entered. GUI software shall create an alarm and log to the alarms database whenever a user logs in or out of the system. In addition, any activity such as setpoint, parameter or schedule changes made by that user shall also be logged to the alarm database. In addition, the GUI software shall provide access level workgroups with the following features:

1. Each workgroup shall have a login graphics page assigned and will display the page whenever a user belonging to the workgroup logs in.
2. Each graphical button, icon and graphics folder shall have a security level and users shall have no access to that item should a user have a lower access level.
3. Each workgroup shall be linked in software to the available alarm groups. If the alarm group is not linked, the user shall have no access to those alarms.
4. Each graphics folder shall be linked to user workgroups. If the folder is not linked to the workgroup, the user shall have no access to the graphics pages within the folder.
5. Each workgroup shall have a logout interval established to automatically log out a user after an inactivity period.

6. Each workgroups users shall have multiple configuration rights to the GUI. Users shall not be able to configure the following GUI functions unless workgroup level permits.

a. Configure data logs or automatic data log recordings.
b. Configure scheduled events.
c. Configure alarm handling filters, groups and retransmissions.
d. Configure, add, delete or edit graphics pages.
e. Close down the software.
f. Configure time schedules or schedule group exceptions.
g. Add or remove controller points from the database.
h. Configure users and workgroups.

M. System tools. GUI shall include context-sensitive online help on the server PC and include dynamic graphical displays on how to operate, edit and configure all functional areas of the software.

N. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

O. Integration capability. GUI software shall have Dynamic Data Exchange (DDE) capability to integrate third-party software packages. If required, provide integration software/hardware from single manufacturer to include:

1. BACnet integration
2. LonWorks integration
3. OPC integration
4. Modbus integration.

P. Web client user interface. Once connected to the BAS server via standard Web browser, Web clients shall have the functionality to access the BAS system without the need for manufacturer's software or files on workstations. Web clients shall have the capability of connection to the server from anywhere on the intranet or Internet. Areas of functionality supported via Web interface to server shall include as a minimum:

1. Security and access. Once a valid username and password is entered, user shall have access to all areas of functionality and graphics supported by their security level as described in this section.
2. Graphics functionality. Color animated graphics pages as created on the server shall be shown identically on a Web browser. They shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters as created on the server from the Web browser.
3. System database functionality. Users shall be able to navigate through the system from the database view of connected DDC systems via site, LAN and controller view format as shown on the server. User shall also have the ability to filter points and change setpoints and schedules from this view.
4. Data log functionality. User shall have the ability to view multi-trace color graphs and data logs from a Web browser.
5. Schedule management functionality. Users shall be able to edit time schedules and add, edit or delete exceptions from a Web browser.

6. Alarm handling functionality. Incoming alarms shall generate alarm panels identically as shown on the server. Users shall be able to action and filter any incoming alarms to the system from a Web browser.

Q. Local display panel. Specified building controller panels shall have a local display panel for monitoring and adjusting the connected controllers parameters, input and outputs. The panel shall have a backlit display with a 4x20 line character set. Each local display shall have the capability to adjust setpoints and time schedules.

2.5 SYSTEM DISPLAY PANEL

A. A display panel shall be provided for any areas where there is no intranet or local system connection and regular user interface is required. Display panel shall be wall or panel-mounted and have a color, backlit LCD touchscreen display. Display shall present users with a familiar windows-based operating environment. System access shall be provided via a navigator tree, enabling controller selection, access to input-output and software point status and values, setpoint and schedule adjustments and viewing of data logs in graph format. System Display Panel shall have the following capabilities as a minimum:

1. Self-learn connected system without the need for any download or database creation.
2. Ethernet connection to system. Display panel shall be able to communicate via TCP/IP over Intranet and Internet connections to remote system.
3. Configurable for 8 individual users with varying access rights to system.
4. Configurable to accept all or certain system alarms. Acknowledge and delete.

5. Alarm Annunciation. Display panel shall be configurable to annunciate alarms in any or all of the following ways:

   a. Flash LED output
   b. Flash screen on and off
   c. Built-in audible alarm.
   d. Close built-in relay alarm contact for activating remote strobe or siren.

6. Provide a System Display Panel in the following locations:

   a. Main Mechanical equipment room

2.6 PROGRAMMING SOFTWARE

A. Building and energy management applications shall reside and operate in controllers. Program software shall be used only to download, edit or modify program applications.

B. Specification. Programming tool shall be a drag and drop, graphical function block windows based application tool and shall create a database of program applications in all building controllers. Program software shall create a file for each building controller on the system. For each building controller there shall be a page of graphical programming information. Each page shall contain a specific sequence of operation carried out by a controller.

C. Documentation. Software tool shall create an 8x11" page for each sequence within a controller. Each page and controller program shall be printed and attached as part of the as-built package supplied by contractor.

D. Communication. Software shall be able to communicate with controllers by direct serial, Ethernet via intranet and Internet or modem connections.

E. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs to building controllers. System shall be fully operable while custom programs are edited and compiled. Programming language shall have the following features:

1. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create all function blocks.
2. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as copy, cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
3. Peer to Peer Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules and controllers.
4. On-line checkout. Software shall have the capability to download, upload and view all program parameters and program function blocks live in real-time when connected to system. Program strategies must be able to be added, deleted or edited live while on-line without the need for download and restart of controllers.
5. Strategy Simulation. Software shall provide simulation mode which simulates a building controller allowing a strategy to be tested before it is downloaded to a controller.
6. Override. Software shall have the capability of overriding any hardware or software value with operator's specified value.
7. Database reconciliation. Operator shall be able to upload controller database and compare to current database diagram. Diagram shall be automatically updated to include all parameter changes since last update.
8. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
9. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values. Both direct and reverse acting PID loops shall be supported. Software shall have PID Loop tuning tool built-in as standard
10. Once a function has been created it shall be re-used and dynamically linked to any page on the controller programming tool.

F. After completion, all programming databases and software shall reside on facilities workstation PC for troubleshooting and editing.

2.7 BUILDING CONTROLLERS

A. General: Provide Building Controllers (BC) as required to achieve sequence of operation. Provide one BC for each piece of mechanical equipment such as air handler, rooftop or central plant application. Controller shall be capable of adequately covering all IO points listed in points list plus 25% expansion capability. Using more than one BC to carry out an equipment application is not acceptable.

B. Stand-Alone Operation. Each BC on the BAS system shall be of true stand-alone operation. All schedules, data logs, time-clock, alarms graphics and program application shall reside in the controller. BCs that require global or master controllers or devices are not acceptable. Each BC shall be able to broadcast data from one to another or globally throughout the system in a true peer-to-peer way, any data value within the controller to any other controller, specified group of controllers, or globally around the system. Controllers shall build LAN and Internetwork communications across data networks and routers and report communications loss to Operator Interface.

C. Hardware Design. BCs must be modular in design and be mounted on standard DIN Rail for ease of replacement and expansion. Every input or output shall have 2-part connectors provided to facilitate commissioning and replacement. BCs shall have a minimum of 16 IO points and be capable of expanding to a total of 128 input-output points through a series of plug in input-output modules. Input-output modules shall be connected to the BC by a CAN network bus and have the capability of being mounted up to 33 feet from controller. Each BC shall provide a serial service communication port for connection to a Portable Operator's Terminal or connection to a local controller display panel.

D. Hardware. Controllers shall be powered by 24VAC or DC and shall be protected by a self-resetting solid state circuit breaker and bus communications shall be protected by a multifuse. Controllers shall be rated to operate at plus or minus 15%. Each BC shall have LED status indication of network, bus, power and controller failure.

E. Environment. Controller hardware shall be suitable for anticipated ambient conditions and mounted in plenum or inside specified equipment. Controllers shall have the following specifications as a minimum:

1. UL916 Listed: Enclosed Energy Management Equipment
2. Temperature: rated at 32°F to 120°F
3. Humidity: 0 to 90%RH non-condensing

F. Memory. BC must have flash memory that is non-volatile to power cycles. Application program and controller parameters must be stored in flash in case of a power outage. Controllers using batteries to store program or parameters are not acceptable. A minimum of 16MB of SDRAM and 8MB of Flash memory shall be employed at each controller.

G. Network communication. Each BC shall have a minimum of one 10BaseT Ethernet port as its primary network communications connection and communicate directly on the buildings TCP/IP data network without the need for master control panels. Each BC shall

have an on-board Web server that will allow local or remote system control, monitoring and configuration via a standard Web browser.

H. BACnet Communication. Each BC shall be native BACnet and integrate seamlessly with a BACnet system, communicating on a BACnet IP LAN at up to 10Mbps.

I. Touch screen display. Provide a touchscreen display which provides an interface to the building controller by way of its local supervisor port. The display shall provide access to modules, graphs, and timezones. Display shall be at a minimum 4" CD touch screen color display, and housed with the electronics in a single unit suitable for rear panel mount applications. The display shall provide a 'Home' screen and the unit shall be programmable with a number of favorite screens.

J. Real Time Clock. Each BC must have a Real Time Clock. In case of a power outage the time-clock must be maintained for 6 days by a capacitor. Any BC shall have the ability to act as the system time-master. System timemaster will automatically adjust to Daylight Savings Times.

K. Sequencing. BC shall execute all program sequences independent of program size once per second. Controller shall execute all program and mathematical functions and PID Loops as described in Section 2.4.E.

L. Scheduling. BC controllers shall provide the following schedule options as a minimum. All schedule, exception or holiday changes shall be configurable from the Web browser interface or the Operator Interfaces.

1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 50 occupied periods (50 start-stop pairs). Days shall have the ability of being copied and pasted from the Web browser.
2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days in advance. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week. Exceptions shall have up to 16 priority levels. Should exceptions overlap, exception with highest priority level shall take precedence over others with lower priorities. Exceptions shall be added, edited or adjusted from the Web browser.
3. Holiday. Web operator shall be able to define holiday exception schedules of varying length on a scheduling calendar that repeats each year.
4. Controller shall support multiple shifted scheduling, enabling start-stop of equipment up to 6 hours before-after normal schedule start-stop. Shifted scheduling shall also support Optimized start-stop.
5. Optimized start-stop. One optstart-stop function shall be assigned to any schedule within the controller. Optstart functions shall be self-learning and shall have operator adjustable start-stop limits.

M. Data Logs. Each BC shall be able to log any data within a controller at one second, 1 minute, 5 minute, 10 minute, 15 minute, 20 minute, 30 minute, 1 hour, 6 hour or 24 hour intervals. 1000 points of data must be held in data log until last value is overwritten. Multiple data logs with differing intervals shall have the capability of being attached to any data point. Any data log shall be viewed from the browser or Operator Interfaces. Data logs shall be viewed in graphical or text format by the operator.

N. Alarms. BCs shall generate alarms configured by the programming tool. Alarms shall be sent to the operator interface workstation. In event that operator workstation is off-line for any reason, alarms shall be sent to the system Display Panel, via email or cell phone text message directly from the controller across the data network to any internal or external email or cell phone email address. Alarms shall have the capability of being sent to different locations depending on schedule status or operator defined alarm group. An internal alarm log shall record the last 50 alarms generated by controller. Alarm log shall be viewed from the browser or Operator Interfaces.

O. Graphics. Each BC shall be capable of containing graphics pages of the connected mechanical equipment as well as the application program. Dynamic data points shall be shown on graphical backdrops representing all hardware and software points within the controller. Graphics pages shall contain links to other graphics pages within the controller, other building controllers on the BAS system, any intranet or Internet Website and any valid email address. Controller shall have the ability to add any user defined text to any graphics page. Graphics pages shall be accessible from any standard Web browser on the intranet or Internet.

P. Security. Each BC shall have username and password security with the ability to have a unique username and password for up to 500 users. In addition, each user shall have a level of access from 0 to 100 to the controller ranging from read only access through to full configuration rights to the controller. Access to the controller shall be read only until a valid username and password is entered via any standard Web browser. All users and levels of access shall be configurable by the operator. Each user shall have a default graphics page assigned and loaded when valid username and password is entered.

Q. Controller Input-Outputs. All controller inputs and outputs may be overridden on-off or by any analog value of the operator's choice via a standard Web browser. In addition an override timer may be initiated to switch all inputs-outputs to automatic operation after user has logged out.

1. Controller inputs shall all be Universal Inputs and be selectable by moving a jumper for the required input type. Controller shall support thermistor, 0-10vdc voltage and 0-20 or 4-20mA current inputs with 12-bit resolution. All digital inputs shall be volt free contacts capable of pulse counting up to 30 pulses per second. When input is selected for digital, LED shall indicate when contact is closed. All sensor scaling and curves shall be software configurable.
2. Controller shall have analog or Form C relay outputs. Analog outputs shall be modulating 0-10Vdc and current limited to 20mA as required to properly control output devices. All analog outputs shall have modulating LED's to indicate output voltage. Analog outputs shall have 11-bit resolution as a minimum. Form-C relay outputs shall have common, normally-open and normally-closed contacts. All relay outputs shall have LED's to indicate relay status.
3. Protection. All input and outputs shall have over-voltage protection built-in to protect main board from failure.

R. PID Loops. Loops shall have the capability to be sequenced once per second and switched between occupied and unoccupied setpoints. In addition, a manual override and level may be initiated and implemented in logic. PID Loops shall support drift-limit

alarm and controlled input alarms. Should controlled input fail or alarm, one of the following actions shall be initiated:

1. Maintain output at level when sensor failed and return to normal operation on alarm clear.
2. Automatically go to pre-defined controlled input value and return to normal operation on alarm clear.
3. Automatically go to pre-defined loop output level and return to normal operation on alarm clear.
4. Automatically go to pre-defined loop output level and stay there until a alarm clears and a manual override is initiated by operator.

S. Runtime Totalization. Controller shall provide an algorithm that can totalize runtime for each digital input or output and calculate the number of starts. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit via the Web browser interface.

T. Staggered Start. Controller shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts via the Web browser interface.

U. Web Browser. In addition, the Web browser interface shall support the following functions on the building controller other than outlined above:

1. Configuration and editing of any function or programming module stored within the controller.
2. Operator override of any function module or software point within the controller in addition to the physical input-outputs.
3. Support of navigation through logic flow diagram to support commissioning via the browser.
4. Display lists of each type of function or programming module within the controller in numerical order and highlight any current alarm points in flashing red format.
5. Operation will be mouse driven point and click between views, graphics and modules. Values shall be changed by drop-down menus or by clicking and typing in open fields.

2.8 BACnet UNITARY CONTROLLERS

A. Provide fully programmable BACnet VAV controllers with or without an on-board actuator. Both shall include a built-in airflow sensor and a pressure transducer. BACnet VAV controllers shall have a pre-loaded strategy and also shall be fully programmable.

B. Provide fully programmable BACnet unitary controllers with universal I/O for terminal equipment control of RTU's, HP, FCU, UV, and others.

C. Network Communication. As a BACnet controller, the unitary controllers shall integrate seamlessly with the building control system, communicating at up to 76.8Kbps on a BACnet MS/TP LAN.

D. Hardware Design. BACnet VAV controller actuator shall be left or right mountable with ability to set actuator to clockwise or counter-clockwise rotation. BACnet unitary

controllers shall be DIN-rail mounted and have software-configurable inputs and outputs allowing for compatibility with a wide range of HVAC and other control and monitoring applications.

2.9 AUXILARY CONTROL DEVICES

A. Low-Voltage Space Thermostats and Aquastats. Low-voltage space thermostats shall be 24 V, bimetal-operated, snap-action switch type, with adjustable anticipation heater, concealed setpoint adjustment, 40°F-90°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

1. Line-Voltage Space Thermostats and Aquastats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.

    a. Line-Voltage Thermostats to be supplied and installed by Division 23 contractor.

2. Low-Limit Freezestats. Low-limit airstream thermostats shall be of vapor pressure type. Element shall be at least 20 ft long. Element shall sense temperature in each 1 ft section and shall respond to lowest sensed temperature. Low-limit freezestat shall be manual reset.

B. Temperature Sensors. Temperature sensors shall be thermistor or 4–20mA dependent on application.

1. Duct Supply Air Sensors. Terminal unit supply duct sensors shall be 6" long thermistor. AHU supply duct sensors shall be 16" long thermistors of type 10KII.
2. Mixed air sensors shall be averaging sensors shall be a minimum of 5 feet in length per 10 ft^2 of duct cross-section. Sensors shall be 10KII type thermistors or generate a 4-20mA signal.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel or brass well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities. Immersion sensors shall be thermistor of type 10KII.
4. Outside Air Sensors shall be mounted on north facing wall and be a 10K type II thermistor. Sensor shall be mounted in a water-proof enclosure.
5. Space Sensors. Space sensors shall be wall mounted thermistors and shall have setpoint adjustment and override button options. See plans for required types and locations. Space sensors shall be 10KII type thermistors and shall have guards fitted on locations shown on plans.
6. Digital Readout Space Sensors. Space sensors shall be wall mounted thermistors and shall have a digital readout of temperature, setpoint and occupancy status. Adjustments shall include setpoint and occupancy. See plans for required types and locations. Space sensors shall be 10KII type thermistors and shall have guards fitted on locations shown on plans.

C. Humidity Sensors:

1. Duct and room sensors shall have a sensing range of 20%-80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.
4. Humidity sensors shall not drift more than 1% of full scale annually.
5. Humidity sensors shall have a 2% rated accuracy.

D. Relays:

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.
3. Relay-in-box. Shall be UL listed and have a compact NEMA 1 housing with ½ or ¾ inch NPT nipples. Relays shall have LED "energized" indication. Wires shall be color-coded. Contact rating, configuration, and coil voltage shall be suitable for application.

E. Current Transmitters:

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be ±1% full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

F. Current Transformers:

1. AC current transformers shall be UL recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

G. Voltage Transformers:

1. AC voltage transformers shall be UL recognized, 600 Vac rated, and shall have built-in overload trip protection.
2. Transformers shall be suitable for ambient temperatures of 40°F-130°F and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

H. Current Switches:

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements. Any current switches used on VSDs shall be specialized for VSD application. Current switches shall be Veris Hawkeye or equivalent.

I. Pressure Transducers:

1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

J. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

K. Local Control Panels:

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door latch and removable sub-panels.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each Building Control panel shall have one 110Vac power outlet for connecting laptops or Portable Operators Terminal.

2.10 ELECTRONIC ACTUATORS AND VALVES

A. Quality Assurance for Actuators and Valves:

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators:

1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.

C. Actuators for damper shall be electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify actuators.
2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
3. Five-year manufacturer's warranty. Two-year unconditional and Three year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
7. A Pushbutton gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24VAC and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside air and exhaust air damper actuators shall be mechanical spring return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer actuators shall utilize analog control 0/2–10VDC, floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.

5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)

E. Control Dampers:

1. The BAS contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment.
2. All dampers used for modulating service shall be opposed blade type and arranged for normally open or normally closed operation as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.

3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
4. Damper linkage hardware shall be constructed of aluminum or corrosion-resistant zinc and nickel-plated steel and furnished as follows:
5. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
6. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
7. Damper manufacturer shall supply alignment plates for all multi-section dampers.

8. Performance Verification Test:

   a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate that is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
   b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.

9. Actuator mounting for damper shall comply with the following:

   a. Damper actuators: Shall not be installed in the air stream.
   b. A weather shield shall be used if actuators are located outside. For damper actuators, use clear plastic enclosure.
   c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
   d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts.

Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.

e. Damper mounting arrangements shall comply to the following:

(1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
(2) No jack shafting of damper sections shall be allowed.
(3) Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.

f. Size damper sections based on actuator manufacturer's specific recommendations for face velocity, differential pressure and damper type. In general:

(1) Damper section shall not exceed 24 ft-sq. with face velocity >1500 FPM.
(2) Damper section shall not exceed 18 ft-sq. with face velocity > 2500 FPM.
(3) Damper section shall not exceed 13 ft-sq. with face velocity > 3000 FPM.

g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8 inches wide by 6 inches deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft-mounting of actuators. Open side of channel shall be faced downstream of the airflow, except for exhaust air dampers.
i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12-inch minimum) shall bring each damper section out of the wall to allow direct shaft-mounting of the actuator on the side of the collar.

2.11 WIRING RACEWAYS AND POWER SUPPLIES

A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.

B. Insulated wire shall use copper conductors and shall be UL listed for 200°F minimum service and be plenum rated.

C. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.

D. Wiring Standards and Identification. Control wiring shall conform to the following standards and color codes:

1.	Ethernet Communication	Orange	CAT5E
2.	Twisted Pair Communication	Orange	22/2
	+ / TX	White	
	- / RX	Black	
3.	Two Wire Sensors	Ivory	18/2/SH
	+	Red	
	-	Black	
4.	Wall Sensors	Satin	6C Flat
5.	Digital Output	Ivory	18/2
	Common	Black	
	Switched	Red	
6.	Analog Output	Ivory	18/2
	+	Red	
	-	Black	
7.	ASC Power	Ivory	18/2
	+ / Hot	Red	
	- / Neutral	Black	

PART 3 - EXECUTION

3.1 EXAMINATION

A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.

B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.

3.2 INSTALLATION

A. Install control units and other hardware on permanent walls where not subject to excessive vibration.

B. Install controller software and implement features of programs to specified requirements and appropriate to sequence of operation.

C. A 120volt alternating current, dedicated power circuit to each programmable control panel shall be provided by Division 26.

D. Mechanical Rooms and exposed locations to be in full conduit.

E. Conduit sleeves in fire rated walls to be caulked with firestop and have bushings on both ends. All conduit stubs and knockouts to have bushings.

F. Plenum rated cable shall be used above drop ceilings and cable paths ran parallel to building structure or structural steel. Plenum cable to be supported at regular intervals by tie-wrap and anchor or tie wrap and bridal ring combinations at no more than 3 foot intervals.

3.3 FIELD SERVICES

A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation. Allow time in this contract to work with commissioning agent if required.

3.4 COORDINATION

A. Site:

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Test and Balance:

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

3.5 GENERAL WORKMANSHIP

A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.

D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.6 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment.

C. Install room temperature sensors in the following ways:

1. On block walls mount on 2 x 4 inch box in wall with ½ inch conduit stubbed out above plenum ceilings.
2. On existing hollow walls mount on 2 x 4 inch box in wall with bushing knockout. If thermostats are to be mounted without box, use anchors. Screws without anchors are not acceptable.
3. On existing filled walls use surface wire mold or conduit depending on location. Coordinate with owner on acceptable method.

D. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

E. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft of sensing element for each 3 ft^2 of coil area.

F. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on north wall at designated location with sun shield.

H. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.

I. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Freezestats may be automatic reset if specified by building owner.

3.7 ACTUATORS

A. General. Mount actuators and adapters according to manufacturer's recommendations.

B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.

1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, then tighten linkage.
3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
4. Provide necessary mounting hardware and linkages for actuator installation.

C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.

3.8 IDENTIFICATION OF HARDWARE AND WIRING

A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 2" of termination.

B. Label pneumatic tubing at each end within 2" of termination with a descriptive identifier.

C. Permanently label or code each point of field terminal strips to show instrument or item served.

D. Label control panels with minimum 1" letters on laminated plastic nameplates.

3.9 SYSTEM CHECKOUT AND TESTING

A. Startup testing. Complete startup testing to verify operational control system before notifying owner of system demonstration.

1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 230900.
2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.

5. Verify that analog output devices such as actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.

7. Alarms and Interlocks:

    a. Check each alarm with an appropriate signal at a value that will trip the alarm.
    b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
    c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.10 TRAINING

A. Provide training for a designated staff of Owner's representatives. Training shall be provided through on-site computer-based training, classroom training, or a combination of training methods.

B. Training shall enable students to accomplish the following objectives:

1. Proficiently operate system.
2. Understand control system architecture and configuration.
3. Understand job layout and location of control components.
4. Understand DDC system components.
5. Understand system operation, including DDC system control and optimizing routines.
6. Log on and off system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules
9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools.
10. Understand system drawings and Operation and Maintenance manual.
11. Access data from DDC controllers.
12. Create, delete, and modify alarms, including configuring alarm reactions.
13. Create, delete, and modify point trend logs (graphs) and multi-point trend graphs.
14. Add new users and understand password security procedures.

C. Provide course outline and materials. Provide one copy of training material per student.

D. Instructors shall be factory-trained and experienced in presenting this material.

E. Perform classroom training using documentation, PowerPoint presentations and software used on installed systems.

F. Provide a total of 16 hours training as part of this contract.

PART 4 – SEQUENCE OF OPERATIONS

4.1 100% OUTSIDE AIR ROOFTOP VENTILATION UNIT (RVU-1):):

A. The building DDC Controller shall enable and disable the unit and control and monitor all points of control described herein. The unit manufacturer's Controller shall start and stop the supply and exhaust fans, control outside air damper, return air damper, heat wheel bypass dampers, stage controls for direct expansion cooling, hot gas reheat and stage gas heat. The controller shall also control the enthalpy wheel rotation, frost control, and alarm points.

B. Occupied: At a predetermined time each morning and after the building has reached temperature setpoint, the DDC Controller shall close a set of contacts, which in turn will enable RVU-1 for operation. The controls shall 100% fully open the outside air damper. Whenever the outside air damper is fully open, an end switch on the damper shall provide positive proof. Upon positive proof, the supply and exhaust air fans and the enthalpy heat wheel shall be energized.

C. A cooling/dehumidification coil discharge air temperature sensor and unit manufacturer's controller shall stage the DX cooling to maintain an adjustable discharge temperature off the cooling coil. Initial cooling coil discharge air temperature setpoint shall be 52°F. A condenser reheat coil discharge air temperature sensor and unit manufacturer's controller shall modulate the condenser reheat valve to maintain an adjustable discharge temperature off the reheat coil. Initial unit discharge air temperature setpoint shall be 72°F. Whenever the outside air temperature is below 50°F, the cooling shall be de-energized. On a continued fall in temperature, the DDC Controller shall stage the unit natural gas heating. Both the cooling coil and reheat coil temperature setpoints shall be adjustable through the DDC system from the operator terminal or field panel.

D. Unoccupied: In the unoccupied mode, the unit shall remain disabled.

E. Smoke Detectors: On detection of products of combustion, the smoke detectors shall stop the unit supply and exhaust fan. The smoke detectors shall be wired directly to the unit's supply and exhaust fan starter.

F. Heat Wheel Failure: On detection of a heat wheel rotational failure, an alarm shall be sent to all network terminals, alarm printers, and the central operator computer.

G. Schedule: Unit shall be scheduled to operate during occupied periods in accordance with the Owner's instructions. Units' startup shall be staggered to avoid electrical overload.

4.2 GEOTHERMAL WATER SOURCE HEAT PUMPS (Base Bid)

A. The BAS/ATC system controller shall have the capability to control the WSHP system through the BAS/ATC graphical interface on the central maintenance BAS/ATC workstations.

B. The BAS/ATC system shall have direct control of space temperature, unoccupied/occupied, start/stop, and override capability.

C. The BAS/ATC system shall report available WSHP system alarms to central maintenance BAS/ATC workstation.

D. BAS/ATC contractor shall obtain the point addresses from the WSHP system manufacturer and program each address for control, monitoring, or alarm by the BAS/ATC system.

E. The units shall operate to maintain the cooling and heating setpoints.

(1) Heat/Cool Setpoint and Mode - The space temperature cooling setpoint shall be determined either by a local setpoint adjustment knob, the unit controller default setpoint, or BAS control. If the BAS is not communicating, the DDC Controller shall use default setpoints or local zone sensor control.
(2) Cooling Setpoint Limiting - The cooling setpoint shall be limited by adjustable parameters in the unit controller or the BAS to prevent it from being set too high or low. The transition from heat to cool shall be based on the time between setpoint change.
(3) Fan Operation - The fan shall run cycle with demand.
(4) Compressor Operation - Compressor operation shall be cycle based upon load conditions as sensed by a zone or discharge air temperature sensor. Compressor operation shall be overridden by a preset three minute minimum on/off time delay in order to maintain oil return when the unit is either initially energized, manually reset, switched between modes, or cycled within a single mode.
(5) Reversing Valve Operation - A contact closure output shall be used to control the reversing valve state. The reversing valve shall be energized in the cooling mode. Once the valve is energized for cooling it shall stay energized until a heating cycle is initiated. The reversing valve operation shall be delayed after compressor shutdown to reduce noise due to refrigerant migration. In the event of a power failure the reversing valve shall fail to the heating mode.
(6) Water Isolation Valve Operation – the Normally closed isolation valves shall be indexed closed unless DX heating, or DX cooling is requested. When the isolation valves are driven open for operation, the outputs shall be driven open 20 seconds to ensure adequate water flow before the compressor outputs are energized. Once an isolation valve has been opened, it shall remain open for a 10 minute minimum to reduce excessive cycling of the valve.

F. Unit Protection:

(1) Compressor Cycle Limit - The compressor shall be operated with minimum 3 minute on and 3 minute off cycles to maintain oil return for extended life of the compressor.
(2) Smart Reset - The unit controller shall automatically try to restart a unit that is locked-out on a high pressure, low pressure, or low temperature detection. This will occur 30 minutes after the diagnostic and if the unit runs successfully the diagnostic is cleared. If the unit undergoes the same diagnostic within a 24 hour period the unit is locked-out until it is manually reset.

(3) Reversing Valve Delay - The reversing valve delay is inherent due to the compressor cycle limit. The delay prevents the reversing valve from changing positions against the large differentials in refrigerant pressures during the change from cooling to heating and visa versa, eliminating the noise normally heard due to refrigerant migration.

(4) Low/High Pressure Cutout - The low pressure switch is a normally closed switch which opens to lock out the compressor under low refrigerant circuit pressure conditions. The high pressure switch is normally a closed switch which opens under high refrigerant circuit pressure conditions which shall lock out the compressor.

(5) Low Temperature Protection - The low temperature protection is intended to sense and prevent water coil freeze-up for low water temperature conditions. A low temperature condition is intended to stop and lockout compressor operation until a reset of the control is done.

(6) Condensate Overflow - A condensate overflow alarm means the switch in the condensate pan has sensed the pan is full and requires servicing. When opened, the condensate overflow switch shall lock out the compressor and fan.

4.3 VARIABLE REFRIGERANT FLOW SYSTEM (Alternate Bid)

A. The BAS/ATC system controller shall have the capability to control the VRF system through the BAS/ATC graphical interface on the central maintenance BAS/ATC workstations.

B. The BAS/ATC system shall have direct control of space temperature, unoccupied/occupied, start/stop, and override capability.

C. The BAS/ATC system shall report available VRF system alarms to central maintenance BAS/ATC workstation.

D. BAS/ATC contractor shall obtain the point addresses from the VRF system manufacturer and program each address for control, monitoring, or alarm by the BAS/ATC system.

1. VRF Indoor Heat pump:

a. Whenever the space temperature setpoint is reset at the graphical interface, the DDC controls shall reset the VRF controls through the BACnet interface to the reset value at the VRF controller. The DDC system shall monitor space temperature through the BACnet interface and report the temperature to the BAS/ATC controls to display on the BAS/ATC graphics.

b. The VRF system occupied/unoccupied schedule for each VRF indoor unit shall be programmed at the BAS/ATC graphical interface and controlled through the BAS/ATC BACnet interface to start/stop each unit individually or as a group.

c. The BAS/ATC controls shall monitor and report filter alarms reported to the VRF system controller through the BACnet interface and send a dirty filter alarm to the BAS/ATCcentral maintenance workstation and display the alarm on the BAS/ATC graphic for the VRF unit.

d. The BAS/ATC controls shall monitor and report "normal/abnormal" alarms reported to the VRF controller through the BACnet interface and send a

"normal/abnormal" alarm to the BAS/ATC central maintenance workstation and display the alarm on the BAS/ATC graphic for the VRF unit.

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4.4 CONDENSER WATER/ GEOTHERMAL LOOP PUMP CONTROL

A. The DDC Controller shall energize the main loop pump.

B. The DDC Controller shall select a different loop pump weekly to act as the main, indexing the other loop pump as a standby. Whenever the DDC Controller senses that the main loop pump has lost flow, the DDC Controller, after a time delay (adjustable) shall start the standby pump.

C. Loop Run Conditions:

1. The following loop water conditions shall be monitored:

   a. Flow status.
   b. Condenser water Supply temperature.
   c. Condenser water Return temperature.
   d. Well field differential pressure

2. Alarms and a system shutdown signal shall be generated upon any of the following loop water conditions.

   a. No Loop Flow.
   b. High Loop Water Supply Temp Shutdown: If the loop water supply temperature is greater than 90°F (adj.).
   c. Low Loop Water Supply Temp Shutdown: If the loop water supply temperature is less than 50°F (adj.).

D. Loop Water Pump Speed Control:

1. The loop water pump speed shall be controlled by the pump's associated variable frequency drive.
2. Current VFD status and operating conditions shall be monitored through its communications interface port. The interface shall monitor and trend the points as shown on the Points List.
3. The controller shall measure condenser water differential pressure and modulate the condenser water pump VFD to maintain its condenser water differential pressure setpoint.
4. The controller shall modulate condenser water pump speeds to maintain an adjustable condenser water differential pressure determined by balancing contractor. The VFDs minimum speed shall not drop below 30% (adj.).

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5. Alarms shall be provided as follows:

   a. High Condenser Water Differential Pressure: If the condenser water differential pressure is 25% (adj.) greater than setpoint.

b. Low Condenser Water Differential Pressure: If the condenser water differential pressure is 25% (adj.) less than setpoint.

4.5 EXHAUST FAN CONTROL

A. Exhaust fan EF-1shall be controlled by the DDC according to the occupancy schedule used by RVU-1.

4.6 ELECTRIC WALL HEATER CONTROL

A. The heater will be controlled by an integral factory supplied thermostat. On a fall in room temperature, thermostat will act to start the unit fan and electric heat as required to maintain the preset space temperature setpoint. On a rise in temperature, the fan and heater will be stopped.

4.7 CABINET UNIT HEATER

A. The cabinet unit shall be controlled by an electric wall-mounted temperature sensor provided and wired by the DDC Contractor. The thermostat shall cycle the fan and electric heating element to maintain space conditions. The heaters shall be enabled for occupied and unoccupied mode by the DDC System.

4.8 INPUT/OUTPUT SUMMARY

A. The Contractor shall be prepared to demonstrate monitoring, and trending of each point shown on the Input/Output Summary.

SYSTEM POINT LIST

SYSTEM POINT DESCRIPTION	ANALOG															
	INPUT											OUTPUT				
Rooftop Ventilation Unit	TEMPERATURE	PRESSURE	RH	KW	GPM	CFM	PPM	PERCENT	PERCENT RLA	SETPOINT		DDC		SETPOINT ADJ.		
SUPPLY AIR	X															
RETURN AIR	X															
EXHAUST AIR	X											X				
OUTSIDE AIR	X					X										
SUPPLY FAN												X				
EXHAUST FAN												X				
UNIT ENABLE/DISABLE																
MIXED AIR	X															
COMPRESSOR																
HOT GAS REHEAT																
REVERSING VALVE																
RETURN AIR DAMPER												X				
OUTSIDE AIR DAMPER												X				
EXHAUST DAMPER												X				
LEAVING WATER	X															
LOW LIMIT																
DISCHARGE AIR	X	X	X											X		
HEAT WHEEL																
HEAT WHEEL BYPASS																
GAS HEAT																
GENERAL NOTES:																

SYSTEM POINT DESCRIPTION	BINARY											
	INPUT						OUTPUT					
Rooftop Ventilation Unit	STATUS	STATUS ON/OFF	FILTER STATUS	CANCEL	OVERRIDE	FAULT	OFF / ON	OPEN / CLOSED	LOCKOUT	ENABLE / DISABLE		
SUPPLY AIR												
RETURN AIR												
EXHAUST AIR												
OUTSIDE AIR												
SUPPLY FAN	X					X						
EXHAUST FAN	X					X						
UNIT ENABLE/DISABLE							X					
MIXED AIR												
COMPRESSOR	X					X						
HOT GAS REHEAT	X											
REVERSING VALVE	X						X					
RETURN AIR DAMPER	X											
OUTSIDE AIR DAMPER	X											
EXHAUST DAMPER	X											
LEAVING WATER												
LOW LIMIT	X											
DISCHARGE AIR												
HEAT WHEEL	X											
HEAT WHEEL BYPASS	X											
GAS HEAT	X											
GENERAL NOTES:												

SYSTEM POINT DESCRIPTION	SYSTEM FEATURES									
	ALARMS									
Rooftop Ventilation Unit	HIGH ANALOG	LOW ANALOG	BINARY	PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	DIAGNOSTICS		
SUPPLY AIR	X	X			X					
RETURN AIR	X	X			X					
EXHAUST AIR	X	X			X					
OUTSIDE AIR	X	X			X					
SUPPLY FAN				X						
EXHAUST FAN				X						
UNIT ENABLE/DISABLE										
MIXED AIR	X	X			X					
COMPRESSOR										
HOT GAS REHEAT										
REVERSING VALVE										
RETURN AIR DAMPER										
OUTSIDE AIR DAMPER										
EXHAUST DAMPER										
LEAVING WATER	X	X			X					
LOW LIMIT			X							
DISCHARGE AIR	X	X			X					
HEAT WHEEL										
HEAT WHEEL BYPASS										
GAS HEAT										
GENERAL NOTES:										

SYSTEM POINT DESCRIPTION	SYSTEM FEATURES																		
	PROGRAMS																		
Rooftop Ventilation Unit	TIME SCHEDULING	DEMAND LIMITING	OPT. START / STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK / SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE			NOTES:
SUPPLY AIR																			
RETURN AIR																			
EXHAUST AIR																			
OUTSIDE AIR																			
SUPPLY FAN																			
EXHAUST FAN																			
UNIT ENABLE/DISABLE																			
MIXED AIR																			
COMPRESSOR																			
HOT GAS REHEAT																			
REVERSING VALVE																			
RETURN AIR DAMPER																			
OUTSIDE AIR DAMPER																			
EXHAUST DAMPER																			
LEAVING WATER																			
LOW LIMIT																			
DISCHARGE AIR																			
HEAT WHEEL																			
HEAT WHEEL BYPASS																			
GAS HEAT																			
GENERAL NOTES:																			

SYSTEM POINT LIST

SYSTEM POINT DESCRIPTION	ANALOG															BINARY												SYSTEM FEATURES																												
	INPUT										OUTPUT					INPUT						OUTPUT						ALARMS										PROGRAMS																		
WATER SOURCE HEAT PUMPS	TEMPERATURE	PRESSURE	CO2	KW	KWH	BTU HR	GPM	PERCENT	CFM	SETPOINT	DDC		SETPOINT ADJ.(manual)			CANCEL	STATUS ON / OFF	FILTER STATUS	ALARM	STATUS	TIMED OVERRIDE	OFF / ON	OPEN / CLOSED	LOCKOUT	ENABLE / DISABLE			HIGH ANALOG	LOW ANALOG	BINARY	PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	DIAGNOSTICS			TIME SCHEDULING	DEMAND LIMITING	OPT. START / STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK / SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE			NOTES:
SPACE	X									X										X								X	X			X																								
FAN																				X																																				
COMPRESSOR																			X	X																																				NOTE 1:
DISCHARGE AIR	X																											X	X			X																								
LEAVING WATER	X																											X	X			X																								
REVERSING VALVE																						X																																		
COND. OVERFLOW																			X											X																										

GENERAL NOTES:

NOTE 1: COMPRESSOR SHALL ALARM ON HIGH/LOW PRESSURE CUTOUT.

SYSTEM POINT LIST

SYSTEM POINT DESCRIPTION	ANALOG															BINARY												SYSTEM FEATURES																											
	INPUT										OUTPUT					INPUT						OUTPUT						ALARMS										PROGRAMS																		
CIRCULATING PUMPS	TEMPERATURE	PRESSURE	CO2	KW	KWH	BTU HR	GPM	PERCENT	CFM	SETPOINT	DDC		SETPOINT ADJ.(manual)			CANCEL	STATUS ON / OFF	FILTER STATUS	ALARM	STATUS	TIMED OVERRIDE	OFF / ON	OPEN / CLOSED	LOCKOUT	ENABLE / DISABLE			HIGH ANALOG	LOW ANALOG	BINARY	PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	DIAGNOSTICS			TIME SCHEDULING	DEMAND LIMITING	OPT. START / STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK / SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE			NOTES:
DIFFERENTIAL PRESSURE (TYP OF 4)		X																	X	X								X	X			X																								
PUMP VFD											X								X	X								X	X		X																									
PUMP RUNTIME											X								X																																					
CONDENSER WATER	X																		X									X	X																											

GENERAL NOTES:

SYSTEM POINT LIST

SYSTEM POINT DESCRIPTION	ANALOG															BINARY												SYSTEM FEATURES																												
	INPUT										OUTPUT					INPUT						OUTPUT						ALARMS										PROGRAMS																		
EXHAUST FAN	TEMPERATURE	PRESSURE	CO2	KW	KWH	BTU HR	GPM	PERCENT	CFM	SETPOINT	DDC		SETPOINT ADJ.(manual)			CANCEL	STATUS ON / OFF	FILTER STATUS	ALARM	STATUS	TIMED OVERRIDE	OFF / ON	OPEN / CLOSED	LOCKOUT	ENABLE / DISABLE			HIGH ANALOG	LOW ANALOG	BINARY	PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	DIAGNOSTICS			TIME SCHEDULING	DEMAND LIMITING	OPT. START / STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK / SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE			NOTES:
EXHAUST FAN																	X		X	X								X	X		X	X						X																		

GENERAL NOTES:

SYSTEM POINT LIST

SYSTEM POINT DESCRIPTION	ANALOG														
	INPUT										OUTPUT				
VARIABLE REFRIGERANT FLOW	TEMPERATURE	PRESSURE	CO2	KW	KWH	BTU HR	GPM	PERCENT	CFM	SETPOINT	DDC		SETPOINT ADJ.(manual)		
OPERATIONAL MODE											X				
FAN SPEED											X		X		
SPACE TEMPERATURE	X												X		
M-NET COMMINICATION											X				
SYSTEM FORCED OFF															

SYSTEM POINT DESCRIPTION	BINARY											
	INPUT						OUTPUT					
VARIABLE REFRIGERANT FLOW	CANCEL	STATUS ON / OFF	FILTER STATUS	ALARM	STATUS	TIMED OVERRIDE	OFF / ON	OPEN / CLOSED	LOCKOUT	ENABLE / DISABLE		
OPERATIONAL MODE		X		X	X							
FAN SPEED					X							
SPACE TEMPERATURE					X							
M-NET COMMINICATION				X	X							
SYSTEM FORCED OFF		X										

SYSTEM POINT DESCRIPTION	SYSTEM FEATURES									
	ALARMS									
VARIABLE REFRIGERANT FLOW	HIGH ANALOG	LOW ANALOG	BINARY	PROOF	SENSOR FAIL	FLOW FAIL	COMM. FAIL	DIAGNOSTICS		
OPERATIONAL MODE	X	X		X	X					
FAN SPEED										
SPACE TEMPERATURE										
M-NET COMMINICATION					X					
SYSTEM FORCED OFF										

SYSTEM POINT DESCRIPTION	SYSTEM FEATURES																		
	PROGRAMS																		
VARIABLE REFRIGERANT FLOW	TIME SCHEDULING	DEMAND LIMITING	OPT. START / STOP	RESET	EVENT PROGRAM	DDC	ALARM INSTRUCT	MAINT. WK. ORDER	RUN TIME	EXP. MESSAGE	SET BACK / SET UP	NIGHT PURGE	TENANT BILLING	CHILLER SEQUENCING	TOTALIZING	TIMED OVERRIDE			NOTES:
OPERATIONAL MODE	X																		
FAN SPEED																			
SPACE TEMPERATURE																			
M-NET COMMINICATION																			
SYSTEM FORCED OFF																			

GENERAL NOTES:

END OF SECTION 230900

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SECTION 232113 – GEO-THERMAL PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 230100, "Mechanical General Provisions," apply to this Section.

1.2 SUMMARY

A. Furnish and install a complete loop heat exchanger to provide an ARI 330 ground source closed-loop heat pump system. Geo-exchange loop exchanger shall be installed per the requirements of the latest edition of the International Ground Source Heat Pump Association (IGSHPA) installation guide, standards, and grouting procedures. Provision and installation of horizontal piping, horizontal trenching and backfilling, vertical boring for vertical loop holes, testing, purging, grouting, and installation of vertical loops are included in this Section.

B. Geo-exchange Loop Exchanger Contractor shall be skilled in the installation of geo-exchange system, have at least five (5) years prior experience, and be recognized in the geo-exchange industry by membership or certification.

D. Geo-exchange Loop Exchanger Contractor shall be responsible for securing all required permits and licenses and paying the required costs.

1.3 QUALITY CONTROL

A. The Contractor shall perform the work in accordance with local, county, state, and federal regulations and codes, including state and federal Environmental Protection Agency regulations.

B. The geo-exchange well loop installer shall have a current IGSHPA certification, having completed an IGSHPA training course in the fundamentals of installation and having passed the IGSHPA certification examination and pipe fusion tests.

C. Geo-exchange well and piping fabricators shall have completed a heat fusion school in which the fabricator performed heat fusion procedures under direct supervision of an IGSHPA-certified heat fusion technician. The fabricator shall be thoroughly familiar with heat fusion procedures, and have had formal training and testing at a heat fusion school under direct supervision of an IGSHPA-certified instructor.

D. Bore hole drillers must exhibit experience in drilling bore holes for geo-exchange heat pump systems on similar projects of 50 wells or more and up to 300' in depth. Qualifications must be submitted for approval.

1.4 WARRANTY-GUARANTEE

A. Contractor shall furnish written warranty, countersigned and guaranteed by the General Contractor, stating that work executed under this Section of the Specifications shall be free from defects of material and workmanship for a period of 12 months from date of Substantial Completion. Refer to Section 230100 for additional warranty period responsibilities.

1.5 SUBMITTALS

A. Submit descriptive literature and manufacturer's technical product data and installation instructions for all geo-exchange loop heat exchanger piping materials and products.

B. The Contractor shall provide a scaled drawing of the bore hole locations and field logs for the work.

C. Refer to Subsection 2.2.D for additional submittal requirements.

1.6 PROTECTION OF PROPERTY

A. The Contractor shall take all reasonable precautions to prevent damage to adjacent property and underground utility lines. Any damage to existing utilities and/or structures shall be immediately repaired at no additional cost to the Owner.

B. The grounds shall be constantly cleared of all dirt, debris, etc., resulting from the Contractor's work. At the conclusion of the work, the site shall be left in a neat, clean condition.

C. Contractor shall provide well-points and a dewatering system to prevent water from flooding the site during the boring operations and draining to adjacent properties. All captured water shall be pumped through hoses. Prevent all surface water and subsurface or ground water from ponding and flooding the site and surrounding areas. Install a dewatering system utilizing well-points or similar methods complete with pump equipment, standby power and pumps, water filters, valves, hoses, appurtenances, water disposal, and water flow controls. Dispose of the water removed in a manner to avoid endangering public health, property, and portions of the site under construction. Provide sumps, sedimentation tanks, and other flow control devices that may be required by local authorities. Before site water can be disposed, Contractor shall obtain the full permission of all local authorities having jurisdiction to release the water into street storm sewers.

D. The Contractor shall coordinate the geo-exchange piping and well locations with all other site utilities and Civil drawings and make necessary adjustments to well locations and piping to avoid conflicts.

PART 2 - PRODUCTS

2.1 POLYETHYLENE PIPING SYSTEM (MAINS AND BRANCHES)

A. This Specification designates the requirements for geo-exchange-system pipe and fittings, made to controlled dimensions, specifications, and requirements as per ASTM D3035 for pipe, ASTM D2683 for socket fusion fittings and ASTM D3261 for butt/saddle fusion fittings.

B. Geo-exchange system piping shall be high density polyethylene resins exhibiting the balance of properties offered by pipe-grade resin possessing the ASTM D3350 cell classification No. 345464C. The approved resin shall be listed in PPI TR4.

C. The extruded pipe sizes and dimensions shall conform to the Specifications and requirements of ASTM D3035. The pipe shall be virgin resin with an allowance for on-site manufacturer re-processed resin. No recycled resin shall be used. The approved pipe product is DRISCOPLEX 5300 Climate Guard pipe.

D. The geo-exchange system pipe fittings which are molded shall be manufactured to the dimensional specifications and requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for butt/saddle fusion fittings). The material used in the manufacturing of the fitting shall be the same approved base resin material as the connecting pipe. The approved fittings are DRISCOPLEX 5300 Climate Guard pressure component fittings.

E. The approved joints are heat fusion, flanging, transition fittings, and proof-tested, approved mechanical "couplers." Fusion joints shall be made by trained and qualified technicians. Refer to QUALIFICATIONS this Section. Socket fusion joints shall be used for pipe sizes 2" and under. Butt fusion joints shall be used for pipe sizes 2-1/2" and larger.

F. The pipe and fittings manufacturer shall have in place a functional quality assurance program. Such QC/QA programs shall deal with quality and workmanship, OA verification, OA rejection, and have OA record retention systems in place. The approved manufacturer is CP CHEM PERFORMANCE PIPE, a division of Chevron Phillips Chemical Company, LP.

G. Each pipe shall be permanently indent-marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture. Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and lot number.

H. The pipe and fittings shall be packaged, handled and stored in accordance with the approved manufacturer's general guidance and recommendations.

I. Construction and installation shall be in general compliance with ASTM D2321 for trench construction, embedment material, bedding, haunching, initial backfill and final cover.

J. The completed system shall be tested in accordance with the specifications of the manufacturer's Manual "Polyethylene Piping Systems Manual."

K. Provide a factory warranty of 25 years for piping and fusion fittings against rust, rot, electrolytic corrosion and defects in workmanship and materials.

2.2 VERTICAL BORE HOLES

A. Vertical bores shall be drilled to sufficient depths to ensure that the entire length of U-tube is inserted. This may require the bore to be drilled several feet deeper than the U-tube length.

B. Vertical bores shall be drilled so the resulting bore diameter is not less than indicated on the drawings.

C. Vertical bore holes shall be constructed and drilled according to all local and state codes for this type of installation.

D. Prior to drilling, the geo-exchange loop exchanger installation subcontractor shall lay out and coordinate location of the vertical bore holes with all the other underground utilities being constructed on the site. The Loop Exchanger Contractor, prior to setting vertical drilling machinery, shall provide a scale coordination drawing to the Architect for approval prior to start of the drilling. The coordination drawing shall be submitted as a shop drawing.

2.3 UNICOIL GEO-EXCHANGE WELL PIPING AND U-BEND LOOPS

A. Provide size, type and quantity of UNICOIL loops as manufactured by CP CHEM PERFORMANCE PIPE.

B. U-bend piping material shall be SDR-9 polyethylene. U-bend shall be pre-fused to the piping at the factory and provided with a pointed base to allow greater ease during bore hole insertion.

C. Piping shall be 3/4" in diameter, or as indicated on drawings. Piping shall be rated for 200 PSI working pressure at 73°F. Piping shall be supplied in continuous lengths suitable for the bore hole depth as indicated on the drawings. Joints in piping in the geo-exchange well shall not be allowed.

2.4 TRANSITION FITTINGS

A. The transition fittings shall be flanged steel to flanged adapter polyethylene fittings with gasket. Transition fitting shall be installed in accordance with manufacturer's Technical Note #33, PD TN 33, April 1996.

2.5 TRENCHING

A. Horizontal piping trenches shall conform to the requirements of the excavation section of the Specifications, Division 2 - SITE WORK, and details shown on the drawings. All underground piping shall be run with metallic identification tape. Refer to the drawings for backfilling requirements.

2.6 THERMALLY ENHANCED GROUT

A. General Information:

1. A 20% solids, modified bentonite grout product which shall be designed to be mixed with fresh water and pumped to its destination. Thermal Grout Lite Grout requires no polymer additives and is a complete mineral base product. The product shall be certified by National Sanitation Foundation International to ANSI/NSF Standard 60. Drinking Water Treatment Chemicals – Health Effects. Thermal Grout Lite Grout shall meet all minimum state regulations for grouting materials.
2. Once placed, Thermal Grout Lite Grout shall set into a semi-rigid plug.

B. Physical Specifications:

Thermal Conductivity	1.0	Btu/hr ft °F
Permeability	$<6.9 \times 10^{-8}$	cm/s
Percent Solids	65.1	%
Grout Weight	13.3	lb/gal
Linear Shrinkage Potential	<11	%
Maximum Particle Size	<300	µm
Unit Yield Range	34.7	gal/unit

PART 3 – EXECUTION

3.1 GEO-EXCHANGE LOOP HEAT EXCHANGER

A. Piping shall be installed in accordance with the manufacturer's instructions.

B. Review overall site utility work with other subcontractors performing site work. Coordinate the laying of the horizontal piping and the vertical bore holes with any existing utilities and all the new site utilities, including storm sewer, sewer lines, electrical lines, domestic water lines, fire protection water lines, footings, foundations, curbs, slabs, catch basins, sidewalks, and other site placed on constructed structures.

C. Examine areas and conditions under which geo-exchange loop heat exchanger systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

D. Header piping shall be buried a minimum of 4'-0" below finished grade. Sharp bends of horizontal pipe around trench corners shall not be allowed. Refer to the drawings for backfilling requirements. Prevent any sharp objects or rock from coming into contact with the pipe by removing all such objects prior to backfilling. Geo-exchange well piping at connection to header piping shall be backfilled by hand to provide proper support of piping and to prevent kinking.

E. Vertical bore holes shall be of a sufficient diameter to accommodate the installation of the U-bend loop and an additional pipe for pumping the grout. Vertical bore holes shall be completely backfilled with a high solids bentonite grout to ensure good heat transfer. Local and state codes concerning backfilling must be followed. A water and bentonite grout mixture must be injected (pumped) into the cuttings left in the bore holes as each drill pipe is pulled out to keep the hole full so that air pockets cannot be pulled in with the U-bend loop as it is pulled in. Bentonite grout manufacturers listed in IGSHPA Manual, "Grouting Procedures for Ground Source Heat Pump Systems," are acceptable and grouting placement, pumping, and mixing methods outlined in the Manual shall be followed.

F. Install piping in accordance with manufacturer's written instructions. Care must be taken to prevent crushing, cutting, or kinking the pipe. Assure piping does not come in contact with sharp rocks or site debris when installing.

G. The pipe and pipe fittings must be joined using the heat fusion process. No other method is acceptable. The vertical loop take-off tee fittings may be made using the saddle fusion process on header piping larger than 1-1/4". Exercise extreme caution to completely remove the cutout material. On header piping 1-1/4" and smaller, use regular tee fittings. Bell reducer fittings, or reducing tees, shall be used at all pipe reductions to eliminate trapped air. Avoid sharp bends in piping. Connect to hydronic water piping using adapter fittings in the mechanical room as indicated or specified above.

H. During installation, trash, soil, and small animals shall be kept out of the pipe. Ends of the high density polyethylene pipe shall be taped and capped until the pipe is joined to the circuit.

I. Make changes in pipe sizes using tapered concentric fittings. Threaded connections shall not be allowed.

J. Each UNICOIL U-bend loop shall be pressure tested at grade prior to drilling of the bore hole. Piping shall be pressure tested for leaks at 100 psi. Leaks shall be repaired in accordance with the manufacturer's instructions. Completely flush and purge U-bend loop prior to connection to the header. U-bend shall be filled with water and pressurized to 40 psi before inserting into the bore hole. Cap ends as required to maintain pressure.

K. After assembly of the entire below grade geo-exchange system, U-bend loops, headers, and mains, the system shall be filled with water and pressures tested to 100 psi. All joints must be inspected prior to backfilling.

L. Prior to connection of the below grade geo-exchange system to the above grade system and prior to backfilling, flush and purge the system of air and flow test to ensure all portions of the system are properly flowing. Utilize a portable purging unit and procedures recommended by IGSHPA to flush and purge the system. Do not connect the below grade geo-exchange system to the above grade system and allow circulation through the heat pumps until flushing and purging is complete. Connection to the above grade heat pump loop shall not be made until authorized by the Engineer and the Owner's Representative.

3.3 REPORT

A. Provide a geo-exchange loop exchanger inspection report that incorporates all the test results, site plan used for coordination, bore hole logs, piping manufacturer's installation instructions, and material specifications.

B. The geo-exchange system test report at the end of this Section shall be provided to the Engineer and Owner's Representative for review and approval prior to connecting below grade system to above grade system.

GROUND HEAT EXCHANGER (GHX) INSPECTION AND TEST REPORT

NOTE: Use separate form for each GHX loop system.

Building:_____ Inspection Date: _____

Ground Heat Exchanger No. or Description: _____

List of WSHP Unit No.'s served by this GHX: _____

Ground Heat Exchanger Design Water Flow - _____ gpm

Calculated purging flow and press to achieve 2 feet/sec

Purging: Flow _____ gpm Head _____ psi, Duration of test _____ min.

Hydrostatic test pressure _____psi; Duration _____ min.

Did system pass the pressure test? _____

Is antifreeze required in system? _____ If yes, was antifreeze measured? _____

Has a dimensioned drawing been prepared, completely and accurately showing the layout of the ground heat exchanger? _____

Does the layout differ substantially from the contract documents? _____

If so, is the deviation approved? _____

Depth of installed vertical loops is _____ feet. (Design is _____ feet.)

Depth of horizontal piping is _____ feet. (Design is _____ feet.)

Are the trenches clear of sharp bends, rocks, or other sharp objects that could restrict flow? _____

Are all joints heat fused (butt-, socket-, or saddle-fusion)? _____

Do the joints have the proper amount of roll-out? _____

Has the piping material been cut-out and properly removed from saddle-fusion tees? _____

Was the system backfilled properly with good clean backfill material? _____

Comments: _____

Inspected and approved this _____ date by _____

Title: _____

END OF SECTION 232113

SECTION 260100- ELECTRICAL GENERAL PROVISIONS

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 SCOPE OF WORK

A. This Section of the Specifications describes the material and installation procedures to be followed for furnishing and installing the electrical equipment and material as outlined and described on the contract drawings and as stated in this Division of the Specifications.

B. Where the word "Contractor" appears in this Division of the Specifications, it applies to the Contractor performing the electrical portion of the work, unless specifically indicated otherwise.

C. The Contractor shall install the systems as specified herein and indicated on the contract drawings and shall furnish all labor, material, tools, scaffolds, erection equipment, services and other items of expense as necessary as a part of this Contract. This Contract further includes placing the systems into operation and properly testing, adjusting, balancing and training the owners personnel on the use of all items of equipment as specified and as approved by the Architect.

1.3 SUPERVISION

A. The Electrical Contractor shall have a designated Supervisor on the job at all times that any electrical work is being installed. This shall include any and all work being accomplished by contractors who are subcontractors to the prime Electrical Contractor.

1.4 DRAWINGS

A. General arrangements of the necessary conduits, feeders, light fixtures, devices, panels, and equipment are indicated on the drawings in diagrammatic form only. Due to the scale of the drawings, offsets, fittings, and accessories may not be shown. Work indicated but having details omitted shall be provided complete to an operating condition with all fittings, wiring, and ancillary equipment and material as required. Where rearrangement is necessary, submit drawings of proposed changes for approval and coordinate and arrange work with consideration to the architectural, mechanical, and plumbing drawings, the existing conditions and to the work of the various other building trades. Equipment provided under this Division of the Specifications shall be installed in accordance with the recommendations of the equipment or material manufacturer.

1.5 COORDINATION

A. Coordinate the electrical work with the architectural, mechanical, and plumbing drawings and work in order to avoid omissions and to eliminate any interference. Report any discrepancies found, as soon as possible, after discovery, to the Architect.

1.6 CODES AND STANDARDS

A. Various recognized codes and standards form a part of these Specifications the same as if written fully herein and shall be followed as minimum requirements. The codes and standards will be referred to by their abbreviated names and are listed below. Reference to these standards shall be understood to mean the latest edition and accumulative supplements which have been adopted by the "Authority Having Jurisdiction," unless noted otherwise.

ADAAG	Americans with Disabilities Act Accessibility Guidelines (July 23, 2004)
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CBMA	Certified Ballast Manufacturers Association
IBC 2009	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
NEC 2008	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Prevention Association
NFPA 70E	Standard for Electrical Safety in the workplace 2012 Edition
OSHA	The Occupational Safety and Health Act
UL	Underwriters Laboratories, Inc.

B. All equipment, material, apparatus, and work shall conform to the requirements of the NEC. If the Contractor observes that the drawings and specifications are at variance therewith, he shall notify the Architect in writing. If the Contractor performs such work contrary to the above referenced rules and regulations and without written acknowledgment or notice thereto, he shall correct this work and bear all cost arising therefrom.

1.7 NOTICES AND FEES

A. Give all required notices, obtain all necessary permits, and pay all required fees, including any fees associated with temporary electrical power services during construction. Utility company fees, which are for the permanent installation of electrical power services, shall be paid for by the Owner.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. See Specification Section 013300, "Submittals," for shop drawing submittal procedures. Submit shop drawings for materials required for this project as indicated herein. Obtain approval from the Architect before manufacture is started on any of same. The shop drawings shall show complete details of the various items, wiring diagrams, etc., and shall be submitted in a sufficient number of copies to allow the Engineer to retain one copy. Approved copies of all shop drawings shall be kept on the job site accessible to the Architect at all times.

2.2 ACCEPTABLE MANUFACTURERS

A. The following list states specific names of acceptable manufacturers of particular equipment and indicates the types of material on which submittals shall be made:

Submittal Information Required:

Light Fixtures . . . . . Product Data
See light fixture schedule on drawings
NOTE: If substitute light fixtures are submitted for review, provide catalog data on the substitution which will provide all the information required to compare it to the specified product. At a minimum, provide dimensional and weight data, coefficients of utilization (CU) information, and photometrics for both the specified and substitute light fixtures. In the case of area lighting, a printout of the foot-candles across the site (to the property line) will also be required. Provide the same catalog data on the specified fixture also. Submittals which don't include both sets of catalog cuts will be returned marked "Furnish Specified Item.")

Power Distribution Equipment (Switchboards,
Panelboards, and Motor Control Centers) . . . . . .Shop Drawings
General Electric Company
Square D Company
Eaton/Cutler-Hammer
Siemens

Lighting Contactors & Disconnect Switches . . . . . Product Data
General Electric Company
Square D Company
Eaton/Cutler-Hammer
Siemens

Wiring Devices and Plates . . . . . Product Data
Hubbell
Levito
Arrow-Hart
Pass and Seymour

B. The following list states other materials for which product data submittals shall be made:

Conductors (each type)
Conduit (each type)
Electro Magnetic Ballast
Electronic Ballasts
Emergency Battery Ballast
Fluorescent Lamps
Master Clock System Components
MC Cable (each type)
Nurse Call Systems Components
Occupancy Sensing Switches (all types)

C. Catalog numbers and manufacturers are listed as a guide for minimum requirements to be met. Material and equipment of manufacturers other than those listed will be given consideration by the Architect providing the material meets the minimum requirements set forth in these Specifications and providing the material or equipment will provide satisfactory performance for the intended installation, does not exceed the dimensions and weight of the specified item and meets the aesthetic performance desired of the specified item. Submittals of other than specified equipment shall have indicated on the specification sheets in the shop drawing submittals each item called for in these Specifications by paragraph and subparagraph numbers and/or letters.

D. See Specification Section 01631 for substitution requirements.

E. Any deviation from the manufacturers listed in the preceding list and /or of those stated in the Contract Documents shall be submitted to the Architect for approval in accordance with Specification Section 260500, "Materials and Methods." Facsimile transmission of data for review will not be accepted.

F. The Architect will review for approval, only one substitute for each type of material specified in the Division 26 Contract Documents. If the substitute material is not approved, the Contractor shall provide the material by one of the specified manufacturers. Approval of substitute material is at the sole discretion of the Architect, and the Contractor shall bear all costs arising therefrom, including any design fees if additional design effort is deemed prudent or necessary by the Architect.

G. Only the types of materials specified herein are approved for use on this project. No other material types will be considered.

PART 3 - EXECUTION

3.1 INSTALLATION

A. "Provide," as used on the drawings and in these Specifications, shall mean furnish, install, connect, adjust, test, and place into operation, except where otherwise specifically stated in the contract documents.

B. Provide coordinated electrical systems, equipment, and material complete with auxiliaries and accessories as required for a complete and operable finished project.

C. Run all conduit concealed except where specifically indicated otherwise. Exposed conduit installation other than where indicated shall be approved by the Architect and Owner prior to installation.

3.2 CLEANING AND PAINTING

A. Remove all dirt, trash, and oil from all raceways, boxes, fittings, cabinets, and panelboards.

B. Protect, to the satisfaction of the Architect, all equipment provided against damage during construction. If damage does occur to any materials, refinish, repair, or replace the equipment or material as directed by the Architect.

3.3 REPAIR OF EXISTING WORK

A. Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

1. Workmanship: Lay out work in advance.

a. Exercise care when cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces as necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings and materials or equipment damaged using skilled craftsmen of the appropriate trades.

2. Existing Concealed Wiring to be Removed:

a. Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors and cut conduits flush with concrete floors, and top openings with grout. Where wood floors are encountered, remove conduit to below wood floor. Where conduit that passes through walls is removed, seal opening in wall with a material that is equal to the material the wall is constructed from.

3. Removal of Existing Electrical Distribution System:

a. Removal of existing electrical distribution system equipment shall include equipment's associated wiring including conductors, cables, exposed conduit, surface metal raceways, boxes, fittings, etc., back to equipment's source or as indicated on the electrical drawings.

4. Continuation of Service:

a. Maintain continuity of existing circuits to remain. Existing circuits shall remain energized unless otherwise indicated. Circuits which are to remain but were disturbed during demolition shall have circuit wiring and power restored back to original condition as approved by the Architect. Only materials specified for this project may be used to effect repairs.

3.4 EXCAVATION

A. All excavations shall be made to the proper depth to assure a firm foundation for the work.

3.5 RECORD DRAWINGS

A. Refer to Specification Section 017839 "Project Record Documents".

3.6 MAINTENANCE MANUALS

A. Refer to Specification Section 017823 "Operation and Maintenance Data".

END OF SECTION 260100

SECTION 260500 - MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Provide all labor, material, tools, scaffolds, erection equipment, services and supplies to fabricate, install, connect, adjust, test, and place in operation the electrical and other systems as called for in these Specifications and as indicated on the Contract Drawings.

B. Properly store and protect all material and equipment until installed.

C. All material and equipment shall be new and of the quality noted or specified. Material, equipment, and work of inferior quality will be rejected. Remove rejected material and equipment shall be removed from the job site immediately upon rejection and replaced and unacceptable work shall be replaced, all by the Contractor at their own expense. The Architect will decide upon the quality of material and equipment furnished and of the work performed.

1.3 WARRANTIES

A. The Contractor shall provide the Owner with a one-year, unlimited warranty (material and labor) on all work accomplished and materials provided under Division 26, including all components thereof except as otherwise noted herein. The warranty start date is the date of project "Substantial Completion" as determined by the Architect.

B. Indoor light emitting diode (LED) fixtures, including the LED arrays and the LED drivers and integral control devices shall be free from defect in material and workmanship for a period of five (5) years from the date of project "Substantial Completed" as determined by the Architect. The LED arrays will be considered defective in material or workmanship if a total of 15% or more of the individual light emitting diodes in the light fixture fails to illuminate.

C. Occupancy sensing lighting control devices (wall mounted, ceiling mounted and wall switch type) shall be free from defect in material and workmanship for a period of five (5) years from the date of project "Substantial Completion" as determined by the Architect.

D. Electromagnetic Florescent and HID Ballasts shall be free from defect in material and workmanship for a period of two (2) years from the date of project "Substantial Completion" as determined by the Architect.

E. Electronic Florescent and HID Ballasts shall be free from defect in material and workmanship for a period of five (5) years from the date of project "Substantial Completion" as determined by the Architect.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Electrical material furnished under these Specifications shall be new and listed by UL and shall bear the UL label where labeling service is available for the type of material provided for this project.

2.2 RACEWAYS

A. Raceways shall be of the size indicated or as required by the NEC; whichever is the larger; except where larger conduits are specified on the Contract Drawings. Raceways shall be 1/2" minimum.

B. Raceways shall be provided for all electrical systems indicated on the drawings unless specifically indicated otherwise. Raceways shall be hot-dip galvanized rigid steel conduit (GRS), electrical metallic tubing (EMT), flexible metal conduit, or intermediate metallic conduit (IMC). Flexible metal conduit in outdoors shall be liquid tight. Schedule 40 PVCconduit may be used only below grade, under concrete slabs-on-grade and other locations where specifically indicated.

2.3 CONDUCTORS

A. Conductors shall be of the American Wire Gauge size indicatedon the contract drawings or specified herein.

B. All conductors shall be copper except as otherwise indicated.

2.4 OUTLETS

A. Outlet and junction boxes shall be of one-piece galvanized construction of a type and size applicable for use in the location indicated on the contract drawings and as required by the NEC.

B. Locations of outlets for lighting, devices, power, and equipment are indicated on the contract drawings. Owing to the small scale of the drawings, it is not possible to indicate the exact location. Examine the architectural, mechanical, and plumbing drawings, and finish conditions and arrange work as required to meet such conditions to the approval of the Architect.

C. Verify the exact swing of doors and locations of furniture and built-in cabinetry prior to installing outlets for switches and receptacles and make the necessary adjustments in location and mounting height of same to avoid conflicts at no additional cost. Coordinate outlets with change orders, addenda, and job site differences.

2.5 FUSES

A. All fuses shall be provided by the Electrical Contractor.

B. Fuses shall be as follows:

1. General: All fuses must carry the UL inspected label. All fuses shall be plainly marked with ampere rating, voltage rating, interrupting capacity when greater than 10,000 Amperes and current limiting where it applies.
2. Interrupting Capacity: Each fuse shall be capable of safely interrupting the maximum short-circuit current available at the point in the circuit where installed.
3. Coordination: Service fuses and the fuses installed in feeder circuits shall be coordinated to provide a selective system of over-current protection.

C. Main, feeder, and branch circuit fuses shall be as follows:

1. Circuits 0 to 600 amperes shall be protected by BUSSMANN Low-Peak, Limitron, or Fusetron (K-5, 200,000 I/C) Fuses rated as indicated on the drawings.
2. Circuits 601 to 6,000 amperes shall be protected by Type KRP-C HI-CAP current-limiting fuses.
3. Motor Circuits: All motors rated 480 volts or less shall be protected by dual-element fuses rated not in excess of 175% and not less than 125% of motor nameplate rating or as indicated. Larger motors as indicated on drawings where fuse gaps are larger than size required for proper rating of fuse, install "all-metal" fuse reducers.

2.6 LABELING

A. Label all disconnect switches, switchboards, panelboards**,** provided under Division 26 of these Specifications.

B. Labels shall be machine engraved, laminated, Bakelite, nameplate type. Labels shall have black faces with white letters, except for fire alarm cabinet and emergency panels where the faces shall be red with white letters.

C. Size of labels shall be based on the required lettering and lettering size. The following are the minimum requirements for each type of label:

1. Switchboard: Branch circuits from switchboard shall be labeled as noted. Lettering shall be 1/4" high.]
2. Panelboards and Transformers: First line of label shall state name of panel as shown on the drawings. Second line shall state from where the panel is fed. Lettering shall be 3/8" high.

Example: Panel L-100 Transformer TC-1
Fed from MDS Fed from Panel #1
Circuit # _____ Circuit # _____]

3. Disconnect Switches/Lighting Contactors/Time Clocks: Disconnect switches, lighting contactors, and time clocks shall be labeled in 1/4" high letters. First line shall state what the switch/contactor is feeding. Second line shall state from which circuit and panel the switch/contactor is fed.]

D. Attach labels with a minimum of two rivets or sheet metal screws. Adhesive-backed labeling will not be accepted.

2.7 PULL BOXES

A. Install pull boxes at all necessary points, whether indicated on the drawings or not, to prevent injury to conductor insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Minimum dimensions shall not be less than the NEC requirements and shall be increased if necessary for practical reasons or where required to fit the job condition.

B. Above grade pull boxes shall be constructed of galvanized sheet steel, code gauge, except that not less than 12 gauge shall be used for any box. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flathead machine screws may be used.

C. All junction and pull box covers shall be labeled indicating the circuits contained therein in a manner that will prevent unintentional interference with circuits during testing and servicing. For example: "HE1-13." See Specification Section 260534 for labeling requirements.

2.8 DISCONNECT SWITCHES

A. Disconnect switches shall conform to governing industry NEMA standards. They shall be listed by UL. Disconnect switches shall be NEMA standard HD, quick-make, quick-break type. Provide disconnect switches where required by the NEC whether indicated or not.

B. Where disconnect switches are indicated or required by the NEC to be weatherproof, furnish NEMA 3R enclosures stainless-steel enclosures. Furnish NEMA 4X enclosures and other spaces where specifically indicated.

C. Arc Flash Warning Labels: Provide all disconnect switches provided by this project with Arc Flash warning labels on the exterior of the switch. CCPS and NNPS only.

2.9 BRANCH CIRCUITS

A. The branch circuit wiring has been designed to utilize the advantages of multi-wire distribution and shall be installed substantially as indicated on the drawings. Major changes in the grouping or general routing of the branch circuits require prior approval in writing from the Architect/Engineer.

B. The number of conductors in each run of conduit is indicated on the drawings, but where there is a conflict between the number of wires indicated and the actual number required as determined by the functional requirements of the connected load, or where the number of wires was inadvertently omitted from the drawings,

the correct number and size of wires as determined by the functional requirements of the connected load shall govern and be provided at no additional cost.

2.10 MOTOR DISCONNECTING MEANS

A. Provide a disconnecting means for each motor when required by the NEC even if not indicated on the drawings. If required disconnects are not shown on the drawings, a circuit breaker in a panelboard or horsepower rated switch will be acceptable as a disconnecting means, if readily accessible and if located within sight of the motor and in compliance with all codes. A quick-make and quick-break general use tumbler or snap switch will be acceptable for capacities of 20 amperes or less and 300 volts and less, provided the ampere rating of the switch is at least double the rating of the equipment controlled. Switches of 30- to 400-ampere capacity shall be of the enclosed, quick-make and quick-break type, heavy duty, horsepower rated. Switches shall disconnect all ungrounded conductors and shall disconnect grounded conductors if required by the NEC to do so. Switches shall be fused when required by the NEC, the manufacturer of the equipment served, UL, or the local authority having jurisdiction whether indicated or not.

2.11 CABLE TIES

A. Provide cable ties in the length required. Standard, indoor cable ties shall be 7.9 inches in length minimum, 0.19 inches in width and 0.47 inches thick. The tensile strength shall be 50 pounds minimum and the maximum bundle diameter shall be 2 inches. Standard cable ties shall be black in color. Plenum rated cable ties shall be 6 inches in length minimum, .075 inches in width and 0.1 inches thick. The tensile strength shall be 50 pounds minimum and the maximum bundle diameter shall be 1.5 inches. Plenum rated cable ties shall be maroon in color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install material in a first-class and workmanlike manner to the satisfaction of the Architect.

END OF SECTION 260500

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SECTION 260518 - METAL CLAD CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specifications Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 DESCRIPTION

A. Metal clad cables may be utilized for branch circuit wiring in walls and above lay-in-tile ceilings only and installed in accordance with NEC 330.

1.3 REFERENCES

A. Metal clad cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Metal Clad Cables, UL 1569. The cable shall bear the UL label and the manufacturer's "E" number.

B. Further, the product shall have passed UL Test Procedure 1479, Through Penetration Fire Rating, and meet NEC 300.22 Wiring in Ducts, Plenums and Other Air-Handling Spaces.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer for a complete installation and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20□C (75□F).

B. Wiring sizes #12 and #10 AWG shall be solid. Larger sizes may be stranded.

PART 3 - EXECUTION

3.1 SPLICES

A. Splicing connectors must have a metal spring that is free to expand. The spring must be suitably coated to resist corrosion. Each connector size must be listed by UL for the intended purpose. The connectors must be suitably color coded to assure that the proper size is used on the wire combinations to be spliced. Each connector must be capable of withstanding 105°C ambient temperatures. The connectors

must be compatible with all common rubber and thermoplastic wire insulations. They must also be capable of making copper-to-copper, copper-to-aluminum, and aluminum-to-aluminum splices. At the Contractor's option, self-strapping electrical tap connectors may be used in wire size and voltage range of the connector. When tape is required for splices, SCOTCHBRAND No. 33, or approved equal, shall be used. Use plastic tape on PVC and its copolymers and rubber-based pressure-sensitive adhesive.The tape must be applicable at temperatures ranging from 0°F through 100°F without loss of physical or electrical properties. The tape must not crack, slip, or flag when exposed to various environments indoor or outdoor. The tape must also be compatible with all synthetic cable insulations as well as cable splicing compounds.

B. Make splices in conductors #8 AWG and larger with solderless connectors, with molded composition covers.

C. Connect conductors #12 and #10 AWG with pre-insulated spring connectors rated at not less than 105°C. Connectors shall be UL approved for fixture and pressure work. Connectors shall be 3M CO. SCOTCHLOK, Type Y, R, and B, or approved equal.

D. Join or terminate conductors #8 AWG and larger with pressure-type copper connectors and properly tape.

E. All branch circuit and control wiring shall be color coded. The color shall be integral with sheath for sizes #12, #10, and #8 AWG. Larger size wire and cable shall be color coded with a minimum 1/2" wide, colored, plastic tape strip. Place strips a minimum of 6" on center anywhere the conductors are accessible and visible. Wire and cable shall be color coded to match existing.

<u>120/208-Volt System</u>
Phase A - black
Phase B - red
Phase C - blue
Neutral - white
Ground - green

F. Advise the Architect if the color coding provided by the utility company differs from that indicated above.

G. MC cable may be used only for receptacle and lighting circuits as follows:

1. MC cable for receptacle circuits may be used to feed classrooms and offices only. The MC cable shall terminate in a junction box above the corridor ceiling immediately outside the classroom or office. Provide conduit from the junction box to the panel from which the circuit originates.
2. MC cable for lighting circuits may be used to feed classrooms, offices, and corridors only. The MC cable shall terminate in a junction box above the ceiling immediately outside of the electrical room. Provide conduit from the junction box to the panel from which the circuit originates.

3. MC cable is acceptable to use above gypsum/plaster ceiling for lighting circuits only. Receptacle circuits run above these ceilings shall be provided in conduit.
4. MC cable may not be run exposed in any location in the building.

3.2 SUPPORT OF CABLE

A. Cable shall be supported at intervals as required by the NEC. Contractor shall supply the necessary additional bracing of an approved material to support the cable. Where long runs of cable need to be supported, the Contractor shall install a trapeze to support the cable.

B. MC cable shall be located same as required for installation of conduit unless otherwise noted elsewhere in the Contract Documents.

END OF SECTION 260518

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SECTION 260519 - CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Feeder and branch circuit wiring shall conform to the requirements of the NEC, and shall meet all relevant ASTM specifications.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer for a complete installation and for the application indicated. Except as otherwise indicated, provide copper conductors with a conductivity of not less than 98% at a temperature of 20°C (75°F). At the Contractor's option, conductors for circuits 100 amps and larger may be aluminum maintaining amperage ratings of the copper conductors specified and providing larger conduits where required, including spare conduit capacity if same is indicated on the plans.

B. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by installer to comply with project's installation requirements, the NEC, and NEMA standards. Select from the following UL types those wires with construction features which fulfill project requirements:

1. Type RHH: For dry locations; max operating temperature 90°C (194°F). Insulation, heat-resistant rubber; outer covering, moisture-resistant, flame-retardant, nonmetallic covering; conductor, annealed copper, compressed stranded.

2. Type USE: Underground service entrance cable identified for underground use; max operating temperature 75°C (167°F). Insulation, abrasion, moisture- and heat-resistant, black vulcanized interlinked polyethylene (VIP^2); conductor, annealed copper, compressed stranded.
3. Type RHW: For dry and wet locations; max operating temperature 75°C (167°F). Insulation, heat-resistant rubber; outer covering, moisture-resistant, flame-retardant, nonmetallic covering; conductor, annealed copper, compressed stranded.
4. Type THWN or THHN: Max operating temperature not to exceed 90°C (194°F) (THHN) in dry locations, or 75°C (167°F) (THWN) in wet or dry locations. Insulation, flame-retardant, moisture- and heat-resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
5. Type XHHW: For dry and wet locations; max operating temperature 90°C (194°F) for dry locations, and 75°C (167°F) for wet locations. Insulation, flame-retardant, cross-linked synthetic polymer; conductor, annealed copper.

C. Service entrance conductors shall be Type XHHW, RHW, or THWN.

D. Direct buried conductors shall be Type USE.

E. Unless specified otherwise, power and lighting conductors shall be 600 volt, Type THWN/THHN, or XHHW.

F. Where light fixtures require 90°C (194°F) conductors, provide only conductors with 90°C (194°F) insulation.

G. Conductors shall be continuous from outlet to outlet with splices made only in pull boxes, junction boxes, and outlet boxes.

H. Do not use wire smaller than #12 AWG for power or lighting wiring.

I. Refer to other Division 26 specification sections for type and size of wiring for Class 1, 2, and 3 circuits (circuits under 120V).

J. Wiring sizes #12 and #10 AWG shall be solid. Larger sizes may be stranded.

K. Where the standard lug sizes on circuit breakers and the main lugs on a main lug only panelboard will not accept the conductor size specified, provide Burndy Compression Type "AYP" or "AYPO" HYPLUGS or approved equal.

PART 3 - EXECUTION

3.1 SPLICES

A. Splicing connectors must have a metal spring that is free to expand. The spring must be suitably coated to resist corrosion. Each connector size must be listed by UL for the intended purpose. The connectors must be suitably color coded to assure that the proper size is used on the wire combinations to be spliced. Each connector must be capable of withstanding 105°C ambient temperatures. The connectors must be compatible with all common rubber and thermoplastic wire insulations. They must also be capable of making copper-to-copper, copper-to-aluminum, and aluminum-to-aluminum splices. At the Contractor's option, self-strapping electrical tap connectors may be used in wire size and voltage range of the connector. When tape is required for splices, SCOTCHBRAND No. 33, or approved equal, shall be used. Use the plastic tape on PVC and its copolymers and rubber-based pressure-sensitive adhesive. The tape must be applicable at temperatures ranging from 0°F through 100°F without loss of physical or electrical properties. The tape must not crack, slip, or flag when exposed to various environments indoor or outdoor. The tape must also be compatible with all synthetic cable insulations as well as cable splicing compounds.

B. Make splices in conductors #8 AWG and larger with solderless connectors, with molded composition covers.

C. Connect conductors #12 and #10 AWG with pre-insulated spring connectors rated at not less than 105°C. Connectors shall be UL approved for fixture and pressure work. Connectors shall be 3M CO. SCOTCHLOK, Type Y, R, and B, or approved equal.

D. Join or terminate conductors #8 AWG and larger with pressure-type copper connectors and properly tape.

E. All branch circuit, feeder, and control wiring shall be color coded. The color shall be integral with sheath for sizes #12, #10, and #8 AWG. Larger size wire and cable shall be color coded with a minimum 1/2" wide, colored, plastic tape strip. Place strips a minimum of 6" on center anywhere the conductors are accessible and visible. Wire and cable shall be color coded to match the existing color coding if an existing color code is present. If there is no existing color code, provide the following:

<u>120/208-Volt System</u>
Phase A - black
Phase B - red

Phase C - blue
Neutral - white
Ground - green

F. After all wiring is completed and connected ready for operation but prior to placing systems in service and before any branch circuit breakers are closed, conduct insulation resistance tests in all feeder circuits. Measure the insulation resistance between conductors and between each conductor and ground. Make measurements with an instrument capable of making measurements at an applied potential of 500 Volts.

G. Take readings after the voltage has been applied for a minimum of one minute. The minimum insulation resistance for circuits of #12 AWG conductors shall be 1,000,000 ohms. For circuits of #10 AWG or larger conductor, a resistance based on the allowable ampacity of the conductor shall be as follows:

25 through 50 Amperes	250,000 ohms
51 through 100 Amperes	100,000 ohms
101 through 200 Amperes	50,000 ohms
201 through 400 Amperes	25,000 ohms
401 through 800 Amperes	12,000 ohms
Over 800 Amperes	5,000 ohms

H. Submit the results of the insulation resistance tests to the Architect/ Engineer for approval. Provide readings for each circuit tested indicating the points between which the circuit was tested, reading, date and time of test, and name of the individual performing the test.]

I. Advise the Architect/Engineer in writing of the tests five (5) working days prior to the date the testing is to commence.]

J. Advise the Engineer if the color-coding provided by the utility company differs from that indicated above.

3.2 TEMPORARY WIRING

A. Temporary wiring is not specified nor governed by this Division of the Specifications.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Provide grounding for service, conduits, motor frames, metal casings, receptacles, and solid neutral, and as required by NEC Article 250.56 as a minimum. Resistance to ground shall not exceed 25 ohms.

PART 2 - PRODUCTS

2.1 GROUND WIRE

A. Provide a green insulated ground wire, sized per the NEC, in all conduits, junction boxes, and pull boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Connect grounding conductors to the panelboard equipment ground bus and not to the panelboard neutral bus. Also connect grounding bushings to the ground bus. Connect the neutral bus only to the system neutral wire. Provide a bonding wire between the equipment ground bus and the neutral bus in the main distribution equipment only. The grounding system (conduit, cabinets, enclosures, and grounding conductors) and the grounded system (neutral conductors and service equipment ground) shall be separate and independent systems, except at the main distribution equipment.

B. Test resistance to ground and submit readings to the Engineer for approval. Include the date and time of the test and the name of the individual performing the test.

END OF SECTION 260526

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SECTION 260529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Extent of supports, anchors, sleeves, and seals is indicated in other Division 26 Sections.

B. Types of supports, anchors, sleeves, and seals specified in this Section include the following:

C-clamps
I-beam clamps
One-hole conduit straps
Two-hole conduit straps
Round steel rods
Expansion anchors
Toggle bolts
Wall and floor seals

C. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 26 Sections.

1.3 QUALITY ASSURANCE

A. Furnish supporting devices manufactured by firms regularly engaged in manufacture of supporting devices of types, sizes, and ratings required.

B. Comply with the requirements of the NEC, as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA FB1, "Fittings and Supports for Conduit and Cable Assemblies."

D. Comply with NECA "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

E. Provide electrical components which are UL-Listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices complying with manufacturer's standard materials, design, and construction in accordance with published product information and as required for a complete installation, and as herein specified. Where more than one type of device meets indicated requirements, selection is installer's option.

B. Provide supporting devices of types, sizes, and materials required, and having the following construction features:

1. Reducing Couplings: Steel rod reducing coupling, 1/2" by 5/8"; galvanized steel; approx. 16 pounds per 100 units.
2. C-Clamps: Galvanized steel; 1/2" rod size; approx. 70 pounds per 100 units.
3. I-Beam Clamps: Galvanized steel, 1-1/4" by 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.
4. One-hole Conduit Straps: For supporting metal conduit through 3/4" galvanized steel; approx. 7 pounds per 100 units.
5. Two-hole Conduit Straps: For supporting metal conduit above 3/4" galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
6. Hexagon Nuts: For 1/2" rod size; galvanized steel; approx. 4 pounds per 100 units.
7. Round Steel Rod: Galvanized steel; 1/2" dia.; approx. 67 pounds per 100 feet.
8. Offset Conduit Clamps: For supporting 2" rigid metal conduit; galvanized steel; approx. 200 pounds per 100 units.

C. Provide anchors of types, sizes, and materials required and having the following construction features:

1. Expansion Anchors: 1/2"; approx. 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" by 4"; approx. 5 pounds per 100 units.

D. Provide sleeves and seals of types, sizes, and materials required, and having the following construction features:

1. Provide factory-assembled, watertight wall and floor seals suitable for sealing around conduit, pipe or tubing passing through concrete floors and concrete block walls. Construct with steel sleeves, malleable-iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps and cap screws.

E. Provide U-channel strut system for supporting electrical equipment, 16-gauge hot-dip galvanized steel of sizes required; construct with 9/16" dia. holes, 8" o.c. on top surface, and with the following fittings which mate and match with U-channel:

Fixture hangers
Channel hangers
End caps

Beam clamps
Wiring stud
Rigid conduit clamps
Conduit hangers
U-bolts

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves, and seals as indicated in accordance with manufacturer's published instructions and with recognized industry practices to ensure supporting devices comply with the requirements of the NEC, NECA, and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including outlet box, raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps, and attachments to support conduit and outlet boxes properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze-type hangers where possible. Install supports with maximum spacings indicated.

D. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Run all conduit concealed, except conduit may be run exposed in mechanical rooms, locations where specifically indicated, and spaces with exposed construction as approved by the Architect.

B. Provide a conduit system complete with fittings and hangers as specified herein and as required by the NEC. Run all electrical wiring systems above 24 Volts in conduit unless specifically indicated otherwise.

C. Install conduit as a complete system without wiring and continuous from outlet to outlet and from fitting to fitting, mechanically and electrically connected to all boxes, fittings, and wireways, and grounded in accordance with the NEC.

D. Cap ends of all conduit promptly upon installation with plastic pipe caps. Caps shall remain until wiring is ready to be installed. Taping the ends of conduits is not acceptable.

E. Size conduit to equal or exceed the minimum requirements of the NEC (except where sizes are specifically indicated on the drawings and in these specifications).

F. Verify exact swing of doors, prior to installing conduit for switches. Coordinate switches with the Architect's plans, change orders, addenda, and job site differences and make the necessary adjustments to avoid conflicts at no additional cost.

G. Coordinate the routing of conduit with other trades to avoid conflicts with structural members, piping, ductwork, and other job site conditions.

H. When PVC conduit is used below grade, it shall be glued together in such a manner so as to make it watertight.

I. Concrete Encased Duct Banks:

1. Construct underground duct lines of individual conduits encased in concrete. The conduit shall be PVC Type EB-35. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3" of concrete cover for ducts. Separate conduits by a minimum concrete

thickness of 2-1/2", except separate lighting and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3".

2. Top of concrete encasement shall not be less than 24" below grade.
3. Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3" in 100'. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25', sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18" for use with conduits of less than 3" in diameter and a minimum radius of 36" for ducts of 3" in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.
4. Terminate conduits in end-bells where duct lines enter underground structures. Stagger conduit joints by rows and layers to strengthen the duct bank. Provide plastic duct spaces that interlock and install per manufacturer's instructions with a minimum of two spacers per 10' of duct bank. Anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring.
5. Duct bank envelopes connection to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12" in each direction.
6. As each section of a duct line is completed from structure to structure, draw a flexible testing mandrel, approximately 12" long with a diameter less than the diameter of the conduit, through each conduit. After which, draw a stiff bristly brush through the conduit, until conduit is clear of particles of earth, sand, and gravel; then immediately install end plugs.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Minimum size conduit shall be 1/2", unless noted or indicated otherwise on drawings. Use larger sizes as required by the NEC to accommodate the number and sizes of wires contained therein.

B. Conduit concealed in walls or above ceilings shall be rigid steel, electrical metallic tubing (EMT), or intermediate metallic conduit (IMC). Flexible metal conduit may be used above accessible ceilings only. Conduit installed below grade and under concrete floors and slabs shall be Schedule 40 PVC, unless otherwise indicated. Conduit run vertically through concrete and into wall cavities shall be GRS or IMC starting at 6" below the bottom of the slab. Where conduits turn up inside a wall cavity, IMC and GRS may be converted to EMT at 6" above the top of the concrete slab. No portion of the conduit radius shall be within the concrete slab.

C. EMT and IMC shall be UL approved, hot-dip, high-strength, galvanized steel.

D. Rigid PVC conduit shall be Schedule 40 (or Schedule 80 if required by the NEC), extruded from high-grade PVC compound and shall be light gray in color. Rigid PVC conduit shall be UL approved for direct burial and concrete encasement.

E. Flexible metal conduit shall be galvanized, continuous spiral, single strip type. In areas subject to moisture such and where specifically indicated, flexible metal conduit shall have a plastic covering in accordance with NEC Article 350. Fittings shall be standard UL approved with ground connector. Watertight connectors shall be used with plastic-covered conduit. All flexible metal conduit installed in shall be plastic covered. The maximum length for flexible metal conduit is 72" unless as otherwise indicated.

F. Conduit may not be run in the flutes of metal roof decking, and may not be attached to any part of metal roof decking.

G. Bury conduit run below grade a minimum of 24" below finished grade or so the top of the conduit is 6" below the bottom of the concrete slab if run underneath concrete unless indicated or required to be deeper. Increase the burial depth as required so that no part of the conduit radius is within the concrete slab where conduits turn vertical. Coordinate conduit routings and depths with all other trades and any and all existing underground utilities.

2.2 FITTINGS

A. All conduit entering or leaving panelboards, cabinets, outlet boxes, pull boxes, or junction boxes shall have lock nuts and bushings, except provide insulated throat connectors on EMT conduit 3/4" and 1". Rigid steel conduit shall have a lock nut both inside and outside of the enclosure entered. Install bushings on the ends of IMC conduit and EMT conduit larger than 1". Insulating bushings shall be OZ Type A for rigid and IMC, and Type B for EMT. Conduit entering enclosures through concentric knockouts shall have grounding-type bushings with copper bond wire to enclosure.

B. Provide expansion fittings where conduits cross building expansion joints. Expansion fittings shall be OZ Type AX with OZ Type BJ bonding jumper. See Architectural drawings for location of expansion joints.

C. Fittings for rigid conduit shall be threaded type, except where IMC changes to EMT above floor slab, fittings shall be threadless type.

D. Fittings for EMT shall be UL-approved, steel, set screw type.

2.3 JUNCTION BOXES

A. Use junction boxes on exposed conduit work for changes in direction of conduit runs and breaking around beams and columns.

B. Furnish covers and gaskets with the junction boxes where installed in damp or wet locations.

C. Label all junction and pull box covers indicating the circuits contained therein in a manner that will prevent unintentional interference with circuits during testing and servicing. For example: "HE1-13." See Specification Section 260534 for labeling requirements.

2.4 PIPE SLEEVES

A. Provide pipe sleeves where conduits larger than 2" pass through walls. Contractor shall be responsible for proper and permanent location. Conduit shall not be permitted to pass through footings, beams, or ribs, unless indicated and/or approved. Coordinate pipe sleeve locations with all other trades affected.

B. Install pipe sleeves and properly secure in place with grout where conduit passes through masonry or concrete and at all fire-rated assemblies. Pipe sleeves shall be of a sufficient diameter to provide approximately 1/4" clearance all around the conduit. Fill void between conduit and sleeve with mineral wool to prevent sound transmission. Pipe sleeves in foundation walls shall be cast iron, 4" larger in diameter than the conduit installed. Pipe sleeves in walls, floors, and partitions shall be Schedule 40 black steel pipe. Extend sleeves above floor at least 1", pack space around conduit with fireproof material, and make watertight. Pipe sleeves passing through firewalls, smoke partitions, fire partitions, or floors shall be sealed with a UL-rated system appropriate for the specified rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install conduit concealed in walls, below floor slabs, and above ceilings, except conduit may be run exposed in mechanical and electrical equipment rooms. Maintain a minimum clear distance of 6" from parallel runs of flues, steam, or hot water pipes. Do not run conduit horizontally in concrete slabs.

B. Use flexible metal conduit (minimum 18" in length, maximum 72" in length) for connections to all motors, dry-type transformers, water heaters, and any equipment subject to vibration.

C. Group conduit so it is uniformly spaced, where straight and at turns. Make bends and offsets (where unavoidable) with a hickey or bending machine.

D. Ream GRS and IMC conduit after threading to remove all burrs.

E. Securely fasten conduit to outlets, junction boxes, and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Running threads are not allowed.

F. Exercise care to avoid condensation pockets in the installations. Keep conduit, fittings, and boxes free from foreign matter of any kind, before, during, and after installation.

G. Do not use EMT below grade, outdoors, in wet locations, or in first floor mechanical/electrical equipment rooms below 48" above finished floor level. EMT is acceptable for use on mechanical mezzanines and in mechanical rooms above the first floor.

H. Support exposed runs of conduit a maximum of every 8 feet apart and parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Support conduit within one foot of all changes in direction and on each side of the change.

I. Supports shall be wall brackets, trapeze, strap hanger, or pipe straps, secured to hollow masonry with toggle bolts; to brick and concrete with expansion bolts; to metal surfaces with machine screws; and to wood with wood screws.

J. Use explosive drive equipment to make connections where the use of this equipment is beneficial, and is subject to strict compliance with safety regulations and approved by the Owner.

K. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited.

L. Do not support conduit from lay in tile ceilings grids, ceiling grid hangers, or lay on ceiling tiles.

M. Paint conduit installed exposed to match the surface on which attached if the surface is painted. Conduit installed on unpainted surfaces need not be painted.

N. Install and support conduit from the underside of the upper chord in bar joist construction.

O. Do not support conduit from or attach outlet or junction boxes to metal roof decks.

P. Do not run conduit in the cavity of exterior walls between brick and CMU.

Q. Seal openings in floors where conduits penetrate vertically through with a clear silicon sealant to prevent liquids and insects from passing through.

R. Where conduits penetrate vertically through fire-rated floors, seal the conduits with a UL-Listed, water-resistant firestop material with a rating equal to or greater than the rating of the penetrated floors.

END OF SECTION 260533

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SECTION 260534 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Furnish and install all junction boxes of a type and size applicable for use in the location indicated on the drawings and where required by the NEC.

B. Exercise special care in the location of outlet and junction boxes in order that the hanging or recessing of light fixtures will not be obstructed by piping or ductwork installed by other trades. To this end, coordinate the work with representatives of the other trades involved and by reference to the architectural, mechanical, and plumbing drawings.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Outlet boxes shall be sheet steel, zinc coated, or cadmium plated.

B. Provide existing and new outlet boxes installed but not used, including data outlets, with blank coverplates matching those provided on adjacent outlets.

C. Size boxes as follows:

1. Switch and Receptacle Outlet Boxes: Provide single gang outlet boxes 1-1/2" deep unless required to be larger. Provide extra deep boxes where required.
2. Fixture Outlets in Ceiling: 4" octagonal, minimum. Where required to accommodate larger conduit or a larger number of wires: 4-11/16" by 2-1/8" deep.
3. One-piece multi-gang boxes for use where two or more switches or receptacles are located side by side: 2-1/8" deep. Sectionalized boxes will not be allowed.
4. Where larger size boxes are required or called for, they shall be similar in all other respects to the types specified above.

D. Light fixture outlet boxes, where fixtures are to be mounted on the box, shall have suitable studs and supports for carrying the weight of the fixture. Increase box depth, as required, for additional wires and conduits.

E. Boxes in new finished walls shall be flush mounted and have flush coverplates and proper type extension rings or plaster covers where required. Provide blank Series 302 stainless-steel coverplates on boxes not scheduled to receive coverplates of an otherwise specified type.

F. Provide boxes located above suspended ceilings with galvanized steel covers, with openings or knockouts as required for type of service.

G. Boxes installed in concrete construction shall be galvanized concrete type at all locations except where condulet or cast-iron boxes are required for watertight or vaportight outlets.

H. Boxes installed in the floor shall be as specified on the drawings and shall comply with the requirements indicated on the drawings. Provide brass carpet flanges where boxes are installed in carpeted areas.

2.2 PULL BOXES AND JUNCTION BOXES

A. Install pull boxes and junction boxes where required for changes in direction, at junction points, and where needed to facilitate wire pulling.

B. Size boxes in accordance with the requirements of the NEC.

C. Boxes shall be constructed of 12-gauge minimum hot-rolled sheet steel and shall be hot-dip galvanized inside and outside to match the conduit. Boxes shall have removable covers.

D. Label the front face of the cover on each box with indelible black marker indicating the number of each circuit contained in or running through the box. In areas where exposed construction is the final finished condition and conduit and junction boxes are called out to be painted, label the inside face of the covers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Check all door swings and coordinate with all furniture, built-in equipment, and cabinetry prior to roughing-in conduit and boxes for switches, receptacles, and auxiliary system devices. Make necessary adjustments in the location of same to avoid conflicts as approved by the Architect and at no additional cost to the Owner.

B. Install all outlet boxes flush with wall or ceiling finish.

C. Mounting heights of outlets in tile or unplastered masonry shall be varied plus or minus to the nearest block joint so the bottom or top of the box rests on a block joint. Install outlet boxes in the same space at the same height above finished floor unless indicated or required to be otherwise.

D. Check the location of all wall outlets prior to roughing-in conduit to verify that the outlet will clear any wall fixtures, shelving, work tables, etc., that exist or will be installed. Make necessary adjustments in the location of wall outlets to avoid conflicts as approved by the Architect and at no additional cost to the Owner.

E. Prior to roughing-in conduit, coordinate with other trades and the Owner regarding all equipment requiring electrical connections. Required adjustments to the conduit and wire sizes shall be made at no additional cost.

F. Conduit installation shall be rigid and secure, and, where necessary, angle iron (1" by 1" by 1/4" or larger) shall be provided to facilitate adequate mounting.

G. Install electrical boxes and fittings in accordance with manufacturer's published instructions, applicable requirements of the NEC and NECA "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

H. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

I. Provide weatherproof "while-in-use" outlet covers for interior and exterior locations exposed to weather or moisture.

J. Provide knockout closures to cap unused knockout holes where blanks have been removed in panel cans, terminal cabinet backboxes, junction boxes, outlet boxes and pull boxes.

K. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

L. Do not install boxes back to back in walls. Provide not less than 6" (150 mm) separation. Thru-the-wall boxes may not be used.

M. Position recessed outlet boxes accurately to allow for surface finish thickness.

N. Set floor boxes level and flush with finish flooring material.

O. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached or solidly embed electrical boxes in concrete or masonry.

P. Subsequent to installation of boxes, protect boxes from construction debris and damage.

Q. Upon completion of installation work, properly ground all electrical boxes.

R. Do not mount boxes to metal roof decking.

END OF SECTION 260534

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SECTION 260573 – SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

C. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS FOR REVIEW/APPROVAL

A. Submit the power system study along with the electrical equipment submittals for review by the Engineer. The electrical power equipment submittals will not be reviewed until the power system study has been received, reviewed, and accepted by the Engineer. Any changes to equipment dictated by the results of the power system study shall be submitted to the Engineer for review prior to any changes being made.

1.5 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted.

B. The report shall include the following sections:

1. Executive Summary
2. Descriptions, purpose, basis and scope of the study
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout
6. Details of the incident energy and flash protection boundary calculations
7. Recommendations for system improvements, where needed
8. One-line diagram

C. Arc flash labels shall be provided in hard copy only.

1.6 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or a consulting engineering firm registered to do business in the Commonwealth of Virginia.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least five actual arc flash hazard analysis it has performed in the past 2 years.

1.7 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program, or equal.

PART 2 - PRODUCT

2.1 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or a consulting engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.2 DATA COLLECTION

A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings.

B. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner and/or Contractor.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

B. Transformer design impedances shall be used when actual test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated
4. Source impedance data, including electric utility system and motor fault contribution characteristics
5. Tabulations of calculated quantities
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point
2. Incoming switchgear
3. Low voltage switchgear
4. Motor control centers
5. Standby generators and automatic transfer switches
6. Branch circuit panelboards
7. Other significant locations throughout the system.

E. 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.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
6. Conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points, where applicable
9. Pertinent generator short-circuit decrement curve and generator damage point
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system switchboards, switchgear, motor-control centers, panelboards, busway and splitters where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performingincident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum andminimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculationwill assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 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 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and loadside of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
3. Reactor data, including voltage rating, and impedance.
4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X"d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated fault current magnitude and angle
    c. Fault point X/R ratio
    d. Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated symmetrical fault current magnitude and angle
    c. Fault point X/R ratio
    d. Calculated asymmetrical fault currents

        (1) Based on fault point X/R ratio
        (2) Based on calculated symmetrical value multiplied by 1.6
        (3) Based on calculated symmetrical value multiplied by 2.7

    e. Equivalent impedance

3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

    a. Voltage
    b. Calculated symmetrical fault current magnitude and angle
    c. Fault point X/R ratio
    d. No AC Decrement (NACD) Ratio
    e. Equivalent impedance

f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
h. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:

a. Current transformer ratio
b. Current setting
c. Time setting
d. Instantaneous setting
e. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

a. Adjustable pickups and time delays (long time, short time, ground)
b. Adjustable time-current characteristic
c. Adjustable instantaneous pickup
d. Recommendations on improved trip systems, if applicable.

D. 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

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

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.

D. Labels shall be machine printed, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one arc flash label shall be provided.
5. For each disconnect switch, one arc flash label shall be provided

F. Labels shall be field installed by the electrical sub-contractor under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING (Ask Owner during design)

A. The contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours).

END OF SECTION 260573

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SECTION 262200 - DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Extent of transformer work is indicated by drawings and schedules.

B. Types of transformers specified in this Section include general-purpose and K4- K13-rated dry-type transformers.

C. Electrical wiring connections for transformers are specified in applicable Division 26 Sections.

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the NEC, as applicable to installation and construction of electrical power distribution transformers.

B. Comply with applicable portions of NEMA TR1, NEMA TR27, and NEMA TP-1 Standards pertaining to power distribution transformers.

C. Comply with applicable requirements of ANSI C57-Series pertaining to power distribution transformers.

D. Comply with requirements of NEMA ST20, "Dry-type Transformers for General Applications," only where dry types are encapsulated or below 15kVA.

E. Comply with applicable requirements of ANSI/UL 506, "Safety Standard for Specialty Transformers." Provide power distribution transformers and components which are UL-Listed and labeled.

F. Comply with applicable requirements of NESC (ANSI C2) pertaining to indoor and outdoor installation of transformers.

PART 2 - PRODUCTS

2.1 POWER DISTRIBUTION TRANSFORMERS

A. Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and

constructed as recommended by manufacturer, and as required for complete installation. All transformers shall be products of a single manufacturer.

B. Dry-type Distribution Transformers: Provide factory-assembled, general-purpose, Encapsulated or less than 15kVA, and NEMA TP-1 compliant and K13-rated, air-cooled, dry-type distribution transformers where shown; of sizes, characteristics, and rated capacities indicated; 3-phase; 60 Hz, 30kV BIL, 4.0% impedance, aluminum windings, with 480-Volts delta connection primary and 208/120-Volts secondary wye connected. Provide primary winding with six 2-1/2% taps; two above and four below primary rated voltage. Transformers 15kVA and above shall be rated for 150°C temperature rise above 40□C ambient except K13- rated transformers shall be rated for 115°C temperature rise above 40°C ambient. All insulating materials shall be in accordance with NEMA ST20 Standard for a 220□C UL component recognized insulation system. Limit transformer surface temperature rise to maximum of 65□C. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector. Equip terminal leads with connectors installed. Provide wiring connectors suitable for copper wiring. Cushion-mount transformers with external vibration isolation supports. Sound levels shall not exceed the following: 15 to 50kVA = 45 dB; 51 to 150kVA = 50 dB; 151 to 300kVA = 55 dB; 301 to 500kVA = 60 dB. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards. Provide transformers with fully enclosed sheet-steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for floor or wall mounting as indicated. The transformers shall be listed by UL for the specified temperature rise.

C. Provide transformers with weatherproof enclosures, whether indicated or not, when installed outdoors.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which power distribution transformers and ancillary equipment are to be installed and notify the General Contractor, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's published instructions (including rear ventilation clearances), applicable requirements of the NEC, NESC, NEMA, ANSI, and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.

C. Connect transformer units to electrical wiring system; comply with requirements of other Division 26 Sections.

D. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

E. Provide 4" thick concrete housekeeping pad under all transformers. Exceed dimensions of transformer by 6" on all sides. Chamfer all exposed edges 1/2".

3.3 GROUNDING

A. Provide equipment grounding connections for power distribution transformers as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounding.

3.4 TESTING

A. Prior to energization of transformers, check all accessible connections for compliance with manufacturer's torque tightening specifications.

B. Prior to energization, check circuitry for electrical continuity and for short-circuits.

C. Upon completion of installation of transformers, energize primary circuitry at rated voltage and frequency from normal power source and test transformers, including but not limited to audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units or components and proceed with retesting.

END OF SECTION 262200

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Extent of panelboard, load center, and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules.

B. Refer to other Division 26 Sections for cable/wire, connectors, and electrical raceway work required in conjunction with panelboards and enclosures; not work of this Section.

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the NEC, as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with the NEC requirements pertaining to installation of wiring and equipment in hazardous locations.

B. Comply with applicable requirements of UL 67, "Electric Panelboards," and UL 50, UL 869, UL 486A, UL 486B, and UL 1053 pertaining to panelboards, accessories, and enclosures. Provide units which are UL-Listed and labeled.

C. Comply with NEMA 250, "Enclosures for Electrical Equipment (1,000 Volts Maximum)," and NEMA PB1, "Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less."

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Except as otherwise indicated, provide panelboards, enclosures, and ancillary components of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with the NEC, UL, and established industry standards for those applications indicated. Series rating of circuit breakers is acceptable.

B. Provide dead-front, safety-type, power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and arrangement shown; with anti-turn solderless pressure-type main lug connectors

approved for copper or aluminum conductors. Specific breaker placement is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Equip with copper busbars with not less than 98% conductivity and with full-sized neutral bus. Provide suitable lugs on neutral bus for outgoing circuits requiring neutral connections. Provide molded-case main and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so an overload on one pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards. Branch mounted main circuit breakers are not acceptable. Provide bottom mounted main breakers for panelboards fed from below. Provide top mounted main breakers for panelboards fed from above.

C. Provide galvanized sheet-steel cabinet-type enclosures, in sizes and NEMA types as indicated, code gauge, minimum 16-gauge thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys. All panelboard enclosures shall be keyed alike. Equip with interior circuit directory frame and card with clear plastic covering. Provide baked gray enamel finish over a rust-inhibitor coating. Design enclosures for flush mounting unless otherwise indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.

D. Provide panelboard accessories and devices, including but not necessarily limited to circuit breakers and ground-fault protection units, as recommended by panelboard manufacturer for ratings and applications indicated.

E. Provide panelboards UL Service Entrance rated when required.

F. Provide panelboards with weatherproof enclosures, whether indicated or not, when installed outdoors.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify the General Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Install panelboards and enclosures as indicated, in accordance with manufacturer's published instructions, applicable requirements of the NEC and NECA "Standard of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

C. Coordinate installation of panelboards and enclosures with raceway installation work.

D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

E. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

F. Provide properly wired electrical connections within enclosures.

G. Provide a typed circuit directory card for each panelboard upon completion of installation work. Indicate load served and room number(s). Use final room numbers obtained from the Architect or Owner, not construction room numbers as shown on the drawings.

3.2 GROUNDING

A. Provide equipment grounding connections for all panelboards. Tighten connections to comply with tightening torques specified in UL 486A and UL 486B to assure permanent and effective grounding.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits and for short-circuits.

D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 262416

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SECTION 262420 - MOTORS AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Furnish and install motors, controllers, and disconnect switches as indicated on the drawings and specified herein.

B. Provide all wiring, disconnect switches, and electrical connections to all equipment provided and requiring electrical connections. Starters and/or contactors, including Variable Frequency Drives ("VFD") for HVAC equipment that is not integral with the HVAC equipment shall be furnished by the Mechanical Contractor and mounted and provided with power wiring by the Electrical Contractor unless otherwise indicated. Power wiring between starters and/or contactors and the final connection point to the HVAC equipment shall be provided under Division 26. The Mechanical Contractor shall provide the proper number and size of auxiliary contacts required by the HVAC equipment.

C. All control wiring and conduits between control instruments and the motor starter serving a piece of HVAC equipment shall be provided by the Mechanical Contractor under Division 23, unless indicated otherwise on electrical drawings.

D. Review the mechanical drawings and specification sections for exhaust fans requiring wall switch and/or thermostat control and provide same as required whether indicated on the electrical drawings or not.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Disconnect switches shall be rated 240 or 600 Volts as required with number of poles and current rating as indicated. Disconnect switches shall be fusible type where indicated, or not indicated but required by the NEC, manufacturer of the equipment served, or the local authority having jurisdiction.

B. Switches shall be NEMA standard HD type.

C. Switches shall be horsepower rated when used for motor disconnect means.

D. Provide fused disconnect switches complete with appropriately sized fuses for the circuits controlled.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed, and notify the General Contractor, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DISCONNECT SWITCHES

A. Coordinate locations of disconnect switches (and magnetic starters furnished under Division 23) with the locations of mechanical equipment, piping, electrical equipment, and any and all other building elements such that all NEC requirements, including working clearances, are met. Adjust locations from those shown on the drawings as required to comply with NEC working clearance requirements at no additional cost to the project.

B. Secure disconnects switches to building or equipment housings where indicated on the drawings. Where building walls or equipment frames do not provide suitable mounting surfaces, provided a galvanized unistrut frame or rack satisfactory in size to securely support the disconnect switch. Where racks are not required to be roof mounted, secure the rack to the roof in a method that does compromise the roof membrane in any way. Submit the roof attachment method to the Architect for approval prior to installation.

3.3 ELECTRICAL CONNECTIONS TO EQUIPMENT

A. Provide electrical connections to equipment indicated in accordance with equipment manufacturer's published instructions and with recognized industry practices and complying with applicable requirements of UL, the NEC, and NECA "Standard of Installation," to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment in accordance with equipment manufacturer's published instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to or greater than the electrical insulation rating of the conductors being spliced.

E. Prepare cables and wires by cutting and stripping covering, armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Avoid "ringing" conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.

H. Provide flexible metal conduit for motor connections and other electrical equipment connections where subject to movement and vibration.

I. Provide liquid-tight flexible metal conduit for connection of motors and other electrical equipment where subject to movement and vibration and where connections are located where subject to any of the following conditions:

1. Exterior locations
2. Moist or humid atmosphere where condensation can be expected to accumulate
3. Corrosive atmosphere
4. Water spray
5. Dripping oil, grease, or water

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 262420

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SECTION 262726 - WIRING DEVICES AND DEVICE PLATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of the electrical distribution systems which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this Section include the following:

Receptacles
Ground-fault circuit interrupters
Switches
Coverplates
Wall Plate type Dimmer Switches
Plugs and Connectors
Floor Service Outlets

C. Comply with the requirements of the NEC, as applicable to installation and wiring of electrical wiring devices.

D. Comply with applicable requirements of UL 20, 486A, 498, and 943 pertaining to installation of wiring devices. Provide wiring devices which are UL-Listed and labeled.

E. Comply with applicable portions of NEMA WD1, "General-purpose Wiring Devices," WD2, and WD5, "Wiring Devices, Specific Purposes."

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES

A. Provide factory-fabricated wiring devices in types and electrical ratings for applications indicated and which comply with NEMA WD1. Provide ivory colored devices, except as otherwise indicated.

2.2 RECEPTACLES

A. Duplex: Provide Industrial/Institutional, Specification-Grade, duplex receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, single-piece brass mounting yoke with integral ground terminals, 20 amperes, 125 Volts,

with metal plaster ears; designed for side and back wiring, with NEMA configuration 5-20R, unless otherwise indicated. LEVITON 5362 Series, or approved equal.

B. Simplex: Provide Industrial/Institutional, Specification-Grade, single receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, 20 amperes, 125 Volts, with metal plaster ears; designed for side and back wiring, with NEMA configuration 5-20R, unless otherwise indicated. LEVITON 5361 Series, or approved equal.

C. Ground-fault Circuit Interrupters: Provide Industrial/Institutional, Specification-Grade, "feed-thru"-type ground-fault circuit interrupters, with heavy-duty duplex receptacles, capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL-rated Class A, Group 1, rated 20 amperes, 120 Volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 mA ground-fault trip level; equipped with NEMA configuration 5-20R. LEVITON model 7899 Series, or approved equal.

2.3 SWITCHES

A. Snap: Provide Specification-Grade, flush, single-pole toggle switches, 20 amperes, 120/277 Volts AC, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, equipment grounding screw, and side-wired screw terminals. LEVITON 1221-2 Series, or approved equal. Provide for key operation where indicated on drawings.

B. Three Way: Provide Specification-Grade, flush, 3-way switches, 20 amperes, 120/277 Volts AC, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, equipment grounding screw, side-wired screw terminals, with break-off tab features, which allow wiring with separate or common feed. LEVITON 1223-2 Series, or approved equal. Provide for key operation where indicated on drawings.

C. Provide Specification-Grade, flush, motor rated switches, 20 amperes, 120/277 Volts AC, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, side-wired screw terminals, single pole, double throw and maintained contact.

2.4 WIRING DEVICE ACCESSORIES

A. Coverplates: Provide ivory colored (unless noted otherwise), nylon coverplates for single and combination wiring devices of types, sizes, and with ganging and cutouts as required. Provide metal screws for securing plates to devices; screw heads colored to match color of plates. Provide stainless-steel coverplates in mechanical and electrical equipment rooms.

B. Provide weatherproof "while-in-use" rated coverplates for receptacles installed outdoors where exposed to weather.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Install wiring devices where indicated in Contract Documents in accordance with manufacturer's published instructions, applicable requirements of the NEC and NECA "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean, free from building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install coverplates after painting work is completed. Label the inside face of each coverplate with indelible black marker indicating the number of each circuit contained in or running through the outlet box.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B. Use properly scaled torque indicating hand tool.

G. Terminate all switch and receptacle wiring on side screw terminals. Back terminations are not permitted.

H. Install all switches and receptacles with sufficient wiring length such that the device may be extracted from the outlet box a minimum of 6" while still connected.

3.2 PROTECTION OF COVERPLATES AND RECEPTACLES

A. Upon installation of coverplates and receptacles, take caution regarding use of convenience outlets. At time of Substantial Completion, replace all coverplates and receptacles which have been damaged; during the execution of this project; including those painted over, burned, or scored by faulty plugs.

3.3 GROUNDING

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounding.

3.4 TESTING

A. Prior to energizing circuitry, test wiring for electrical continuity and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 262726

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SECTION 264313 – PANELBOARD SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, Section 260100, "Electrical General Provisions," and Section 260526, "Grounding," apply to this Section.

1.2 SCOPE OF WORK

A. Provide panelboard surge protection devices with electrical and mechanical requirements for an 80,000-Amp per mode, Surge Protection Device (SPD) with L-N, L-G, L-L, and N-G Mode Protection and parallel design using fast-acting transient energy protection that will divert and dissipate the surge energy.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

Underwriter's Laboratories, Inc. (UL)
UL Standards 1449 3rd edition 1283 (complementary listing for Type Locations)

B. IEEE Compliance:

IEEE Standards C62.11 (2005), C62.33 (1982), C62.41 (1991), C62.45 (2002)

1.4 CODES AND STANDARDS

A. Transient voltage surge suppressors shall be listed and labeled per UL 1449 latest edition, and UL 1283, and comply with ANSI-IEEE C62.45 test procedures for all categories established in C62.41 (1991).

B. ANSI/IEEE Std. 1100-2005 Section 8.6.1 (Emerald Book).

C. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz).

1.5 MANUFACTURER QUALIFICATIONS

A. The surge protection device shall be manufactured by an ISO 9001-2001 certified company normally engaged in the design, development, and manufacture of such equipment.

1.6 WARRANTY

A. The SPD unit shall be guaranteed by the Installing Contractor and surge protection manufacturer to be free of defects in materials and workmanship for a period of

not less than 5 years from the date of Substantial Completion of the system to which the SPD is installed.

B. The SPD unit, which depicts evidence of failure, malfunction, or incorrect operation during the 5-year warranty period, shall be replaced as a complete unit, if necessary, not just modules, subassemblies, or components by the manufacturer at no charge to the Owner.

1.7 SUBMITTALS

A. SPD submittals shall include, but shall not be limited to the following items:

1. Complete schematic data for ALL SPDs indicating part numbers, conductor sizes, etc.
2. Dimensioned drawing of each SPD type indicating mounting arrangement.
3. Manufacturer shall include their UL 1449 3rd edition, listing classification page and listing number(s) showing the Suppressed Voltage Ratings (SVR) as well as all "Engineering Considerations."
4. Provide third party test documentation demonstrating that the SPD is capable of surviving the specified Maximum Surge Current Rating. The documentation will clearly demonstrate that tests have been performed on a COMPLETE device, including all necessary fusing, disconnects, and monitoring systems.
5. Provide data demonstrating that the device is capable of surviving the specified number of repetitive ANSI/IEEEC62.41 Category C3 (10kA) impulses without failure or performance degradation of more than 10%.
6. Provide test data demonstrating that the device is capable of surviving the specified short circuit current rating (AIC) per the requirements of NEC Article 285.6.
7. Provide COMPLETE data package per the recommendations of NEMA LS-1 (1992).

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICE (SPD)

A. The Surge Protection Device (SPD) shall be of a parallel design using fast-acting transient energy protection that will divert and dissipate the surge energy. The SPD shall be UL-Listed at or above the available fault current level at the point of SPD application by UL, per UL 1449 3rd edition. The SPD shall be marked with the short circuit current rating. The SPD's short circuit rating shall be 80kAIC. SPD device can not utilize current limiting fuses. The SPD shall be self-restoring and fully automatic. The maximum continuous operating voltage shall be capable of sustaining 115% of nominal RMS voltage continuously without degrading in accordance with NEMA LS-1 (1992). The SPD shall only use solid-state clamping components to limit the surge voltage. SPD components that "crowbar" or short-circuit the AC power system (e.g., spark gaps, gas tubes, selenium cells, or SCRs) are not acceptable. (service entrance, distribution panels and branch panelboards) shall be supplied by the same manufacturer.

B. Mode Protection: The SPD system shall provide MOVs configured to provide protection in all possible modes (L-L, L-N, L-G & N-G). Unless otherwise noted, provide NEMA 1 enclosure for indoor mounting and NEMA 3R enclosure for all outdoor locations. The SPD device shall provide a minimum protection of 80kA per mode (L-L, L-N, L-G & N-G) capable of surviving at least 5,000 sequential Category C3 impulses. The unit shall have panel front status monitors to indicate a continuous positive status of each protected phase, form "C" contacts, and internal surge tested fuses. Fuse shall not open under surge conditions and shall protect the device against thermal runaway.

C. The SPD shall have a UL-1449, 3rd edition Voltage Protection Rating (VPR) as follows:

	10-25-10
Mode	208Y/120
L-L	1200v
L-N	700v
L-G	700v
N-G	700v

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the SPD with #10 AWG minimum conductors to 30-amp breaker(s) in panel per manufacturer's installation instructions. The 3-pole breaker will be provided by the panel manufacturer. Locate the SPD as physically close as possible to the panelboard neutral and locate the SPD breaker as close as possible to the SPD location. The conductors serving the SPD shall be twisted together to reduce the SPD system input impedance and kept at the minimum length. The SPD shall be installed in strict accordance with the manufacturer's recommended practices and in compliance with NEC requirements. Measured impedance may not be higher than 5 ohms on the ground for the service entrance SPD device.

B. If lead lengths exceed 18", the Contractor responsible for installation ***must*** contact the surge suppression manufacturer for installation assistance.

3.2 GROUNDING CONNECTORS

A. Connectors, splicers, and other fittings used tointerconnect ground conductors, bond to equipment or grounding bars, shall be approved by NEC or UL for their purpose.

B. All connectors and fittings shall be of the Nicopress crimp or compression setscrew type.

C. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.

3.3 FINAL INSPECTION

A. The surge protection installation shall be inspected by a licensed electrician to verify proper system voltage, SPD voltage, configuration, and installation in accordance with the NEC. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documents/manual.

END OF SECTION 264313

SECTION 265100 - INTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 DEFINITIONS

A. Total Harmonic Distortion (THD): The sum of the root mean square (RMS) current (or voltage) of each of the individual harmonic frequencies divided by the root mean square (RMS) of the fundamental current (or voltage).

1.3 SCOPE OF WORK

A. Extent of interior light fixture work is indicated by drawings and schedules.

B. Light fixtures shown installed on exterior walls or under canopies attached to the building are considered interior building lighting.

C. Types of interior light fixtures in this Section include the following:

Fluorescent
Incandescent/Quartz Halogen
High Intensity Discharge (HID)

1.4 QUALITY ASSURANCE

A. Comply with the requirements of the NEC, as applicable to installation and construction of interior building light fixtures.

B. Provide interior light fixtures which are UL-Listed and labeled.

C. Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBMA label.

PART 2 - PRODUCTS

2.1 INTERIOR LIGHT FIXTURES

A. Provide light fixtures of sizes, types, and ratings indicated; complete with, but not limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, and wiring. Provide fixture trims as required for proper installation into the type ceiling in which installed. Review Architectural reflected ceiling plans for ceiling types and construction and provide all mounting hardware required for proper installation of the fixtures specified for the location.

2.2 FLUORESCENT LIGHT FIXTURES

A. Fluorescent fixtures shall be in compliance with UL and be furnished with electronic ballasts unless specifically indicated otherwise.

B. The "master/slave" concept of ballast control will not be allowed. Provide ballasts in each light fixture as required to comply with the switching requirements indicated on the drawings.

C. Fluorescent Electronic Ballasts: The electronic ballast shall as a minimum meet the following characteristics:

1. Ballasts shall comply with UL, ANSI, and NFPA, unless specified otherwise. Ballasts shall be designed for operation of the lamps in the indicated application. Ballasts shall be designed to operate on the system voltage to which they are connected.
2. Power factor shall be 0.98 (minimum). Lamp current crest factor shall be 1.7 (maximum).
3. Ballasts shall operate at a frequency above 40,000 Hz (minimum).
4. Ballasts shall have light regulation of ±10% lumen output with a ±10% input voltage regulation. Ballasts shall have 10% flicker (maximum) using any compatible lamp.
5. Ballasts shall be UL-Listed Class P with a sound rating of "A."
6. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballasts shall have circuit diagrams and lamp connections displayed on ballast packages. Ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Ballast lamp lead wire color code shall comply with ANSI for parallel or independent lamp operation.

7. Ballasts shall operate in a programmed rapid start mode.

8. Ballast factor shall be 88% (minimum).

a. T-8 Lamp Ballast: Ballast shall be capable of starting and maintaining operation at a minimum of 50°F for F28T8 lamps, unless otherwise indicated. Provide fluorescent ballasts having a minimum starting temperature of 0°F in fixtures mounted **[in cold rooms], [outdoors], [in unheated buildings], [where specifically indicated] and [as indicated]**

(1) Total Harmonic Distortion (THD): Shall be less than 10%.

(2) Input Wattage: Programmed rapid start mode

26 watts (maximum) when operating one F28T8 lamp
48 watts (maximum) when operating two F28T8 lamps
71 watts (maximum) when operating three F28T8 lamps
96 watts (maximum) when operating four F28T8 lamps

(3) Provide three and four lamp fixtures with two ballasts per fixture to accommodate multi-level switching in spaces where multiple switches are shown.

(4) A single ballast may be used to serve multiple fixtures if they are continuously (row) mounted and factory manufactured for that installation with an integral wireway.

b. T-5 Long Twin Tube Lamp Ballast: Ballast minimum starting temperature 50°F.

(1) Total Harmonic Distortion (THD): Shall not be greater than 25% when operating one lamp, 15% when operating two lamps, and 20% when operating three lamps.

(2) Input Wattage: programmed rapid start mode

44 watts (maximum) when operating one T-5 lamp
78 watts (maximum) when operating two T-5 lamps
122 watts (maximum) when operating three T-5 lamps

(3) Provide three and four lamp fixtures with two ballasts per fixture to accommodate multi-level switching in spaces where multiple switches are shown.

(4) A single ballast may be used to serve multiple fixtures if they are continuously (row) mounted and factory manufactured for that installation with an integral wireway.

D. Fluorescent Lamps: Fluorescent lamps contain Mercury, therefore are classified as hazardous waste. The Contractor is responsible for the handling and/or disposal of fluorescent lamps in accordance with all Federal, State, and Local Regulations.

1. Only low Mercury lamps which require no special handling during disposal shall be provided for this project when available for the lamp types and sizes specified herein.
2. T-8 rapid start lamps shall be rated 28 watts (maximum), 2,750 initial lumens (minimum), SP30, CRI of 84 (minimum), color temperature of 3,000 K, color temperature of 4,100 K, and 30,000 hours average rated life.
3. T-8 rapid start lamp, 17 watt (maximum), nominal length of 24", 1,300 initial lumens (minimum), CRI of 85 (minimum), color temperature of 3,000 K, and 24,000 hours average rated life.

4. Compact fluorescent lamps shall be 3,000 K and 10,000 hours average rated life, and as follows:

a. T-4, twin tube, rated as indicated in light fixture schedule.
b. T-4, double twin tube, rated as indicated in light fixture schedule.

5. Average rated life is based on 3 hours operating per start.

E. Compact Fluorescent Fixtures: Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Fixtures shall use lamps atypes as recommended by the fixture manufacturer.

F. Open-Tube Fluorescent Fixtures: Provide with self-locking sockets, or lamp retainers (two per lamp). Provide lamps with shatter resistant coating, non-yellowing, nominal thickness of 15 mils, and with 97% (minimum) light transmission. Provide a clear polycarbonate protective sleeve over lamp, with 95% (minimum) light transmission.

G. Air-Handling Fixtures: Fixtures used as air-handling registers shall meet requirements of NFPA.

2.3 HIGH-INTENSITY-DISCHARGE (HID) LIGHT FIXTURES

A. Fixtures shall be in compliance with UL.Provide HID fixtures with tempered glass lenses when using metal-halide lamps. Fixtures installed in gymnasiums shall be provided with wire lenses guards, ballast to fixture safety chains, and wire guard to reflector safety chains.

B. HID Ballasts: Ballasts shall be in compliance with UL and ANSI and shall be constant wattage autotransformer (CWA) or regulator, high-power-factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30°C. Ballasts shall be:

1. Designed to operate on the voltage system to which they are connected.
2. Designed for installation in a normal ambient temperature of 40°C.
3. Constructed so that open circuit operation will not reduce the average life.

C. High-pressure-sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3,500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90°C in any mode.

D. HID Lamps: Provide the number, type, and wattage indicated in the light fixture schedule. Lamps shall be manufactured by GENERAL ELECTRIC, PHILLIPS, SYLVANIA, or as recommended by the light fixture manufacturer.

E. Metal halide fixtures manufactured after January 1, 2009, shall comply with the Energy Independence and Security Act of 2007.

2.4 INCANDESCENT AND QUARTZ HALOGEN LIGHT FIXTURES

A. Fixtures shall be in conformance with UL.

B. Incandescent Lamps: Provide the number, type, and wattage indicated in the light fixture schedule. Lamps shall be manufactured by GENERAL ELECTRIC, PHILLIPS, SYLVANIA, or as recommended by the light fixture manufacturer.

C. Quarts Halogen Lamps: Provide the number, type, and wattage indicated in the light fixture schedule. Lamps shall be manufactured by USHIO, PHILLIPS, SYLVANIA, or as recommended by the light fixture manufacturer.

2.5 RECESS- AND FLUSH-MOUNTED FIXTURES

A. Provide light fixture types which can be relamped from the bottom. Access to ballasts shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as required for the ceiling construction in which it is installed.

2.6 SUSPENDED FIXTURES

A. Provide hangers capable of supporting twice the weight of the fixture supported by the hanger. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size required. Hangers shall be shock-absorbing type where indicated. Hangers shall allow fixtures to swing within an angle of 20 degrees. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end, unless indicated otherwise. Rods shall be a minimum .18" diameter.

2.7 EXIT SIGNS

A. Signs shall be in conformance with UL and NFPA. Exit signs shall be self-powered type where indicated.

B. Self-Powered LED-Type Exit Signs (Battery Backup): Provide with automatic power failure device, test switch, pilot light and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1.5 hours (90 minutes) minimum.

2.8 EMERGENCY LIGHTING EQUIPMENT

A. Equipment shall be in conformance with UL and NFPA. Provide lamps in wattage indicated.

B. Emergency Lighting Unit: Provide as indicated. Emergency lighting units shall be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted lamps may be rated 6 volts. Equip units with brown-out sensitive circuit to activate battery when AC input falls to 75% of normal voltage and 15-minute time delay feature for areas with HID lighting. Provide integral self-testing module.

C. Fluorescent Emergency Battery-Ballast: Each unit shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Charger shall be either trickle, float, constant-current or constant-potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to one lamp for 90 minutes at a minimum of 1,100 lumens per lamp output. Battery shall operate unattended and require no maintenance for a period of not less than 5 years.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install interior light fixtures at locations and heights as indicated in accordance with fixture manufacturer's published instructions, applicable requirements of the NEC,

NECA "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that light fixtures fulfill requirements.

B. Coordinate with all other work on this Contract as appropriate to properly interface installation of interior light fixtures.

C. Fasten fixtures securely to building structural members, and check to ensure that solid pendant fixtures are plumb. Recessed fluorescent fixtures shall be supported with individual annealed, light zinc-coated finish, 12-gauge wire from all four corners tied to building structural members. Securing safety wires to bridging is not acceptable.

D. Clean interior light fixtures of dirt and debris (including lenses) upon completion of installation.

E. Protect installed fixtures from damage during entire construction period.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of interior light fixtures and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

B. At the time of Substantial Completion, replace lamps in interior light fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Architect.

3.3 GROUNDING

A. Provide tight equipment grounding connections for each interior light fixture installation.

END OF SECTION 265100

SECTION 265600 - EXTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 SCOPE OF WORK

A. Extent of exterior light fixture work is indicated by drawings and schedules.

B. Type of exterior light fixtures in this Section include:
High-Intensity-Discharge (HID): Metal Halide and High-Pressure-Sodium

1.3 QUALITY ASSURANCE

A. Comply with the requirements of the NEC, as applicable to installation and construction of exterior building light fixtures.

B. Comply with applicable requirements of NEMA FA1, LE1, and LE2 pertaining to lighting equipment.

C. Comply with applicable requirements of ANSI and ANSI/IES standards pertaining to exterior light fixtures and components.

D. Provide exterior light fixtures which are UL-Listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide light fixtures of sizes, types, and ratings indicated; complete with, but not limited to, housings, lamps, lamp holders, reflectors, ballasts, starters, wiring, conduit, poles, and foundations.

B. Ballasts shall be manufactured by ADVANCE, VALMONT, or UNIVERSAL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install exterior light fixtures at locations and heights as indicated in accordance with fixture manufacturer's published instructions, applicable requirements of the NEC, NECA "Standard of Installation," NEMA standards, and recognized industry practices to ensure that light fixtures fulfill requirements.

B. Coordinate with other electrical work as appropriate to properly interface installation of exterior light fixtures with other work of this project.

C. Fasten fixtures securely to structural supports and check to ensure that solid pendant fixtures are plumb.

D. Install light poles in accordance with manufacturer's published instructions, in compliance with NESC and NECA "Standard of Installation," to ensure that poles comply with requirements.

E. To protect finishes, use belt slings or rope (not chain or cable) to raise and set finished poles.

F. Where poles are indicated to be embedded in soil, set poles approximately 1/6 of pole length, but not less than a 5'-0" depth below finish grade.

G. Set poles plumb. Support adequately during backfilling or when anchoring to foundations.

H. Provide sufficient space encompassing hand access and cable entrance holes for installation of cables from underground where indicated.

3.2 ADJUST AND CLEAN

A. Clean exterior light fixtures of dirt and debris upon completion of installation.

B. Protect installed fixtures from damage during remainder of construction period.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of exterior light fixtures and after energizing branch supply circuitry, apply electrical energy to light fixtures to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. At the time of Substantial Completion, replace lamps in exterior light fixtures which are observed to be noticeably dimmed or different in color after Contractor's use and testing as judged by the Architect.

3.4 GROUNDING

A. Provide tight equipment grounding connections for each exterior light fixture installation where indicated.

B. Provide equipment bonding and grounding connections, sufficiently tight to assure permanent and effective grounding, where indicated, for installed poles.

END OF SECTION 265600

SECTION 275123 – INTERCOMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Section 260100, "Electrical General Provisions," apply to this Section.

1.2 DESCRIPTION OF WORK

A. Provide the highest quality materials, equipment, and workmanship available, to fulfill the requirements of the work specified herein.

B. Provide an intercommunication system capable of being completely interfaced with and accessed by an Owner-provided telephone system.

C. The intercommunication system must be capable of being accessed by any telephone instrument which is a part of the Owner's telephone system.

D. The installation of the new intercom system head-end equipment, including connection of existing intercom system cables and connection of new intercom system cables from new addition to the new intercom system head-end must be completed, tested and approved by building official.

1.3 WORK INCLUDED

A. The work consists of furnishing all labor, equipment, supplies, materials, and incidentals and in performing all operations necessary for the "TURNKEY," fully operational, and completed installation of an Intercommunication in complete accordance with the Specifications and the accompanying drawings.

B. The work shall include, but not be limited to, the following:

1. Coordination of the Raceway installation
2. Provide Special Backboxes required
3. Provide Conductors and Cables as required
4. Provide all Intercom, Public Address, and Cabinets and Enclosures
5. Provide the Cable Distribution System

1.4 SUBMITTALS

A. Submit the following Shop Drawings and Submittals, per the schedule listed below, for review by the Architect/Engineer:

1. Prior to proceeding with the work:

a. A complete schedule of ALL equipment and materials which are to be furnished for the work. Accompanying the schedule shall be

manufacturer's specification or data sheets for all major components listed in Part 2 of this Specification.

b. Shop Drawings: Complete shop drawings for all systems and assemblies specified. Provide the FCC registration number of the system being proposed as a part of the submittal process. Each drawing shall have a descriptive title, and all subparts of each drawing shall be labeled. All drawings shall have the name and location of the project in the title block. Intercommunication and Clock Systems shop drawings shall not be combined with any other auxiliary system shop drawings.

c. Cabinets & Assemblies: Complete CAD-generated, 1/4" scale drawings of all equipment racks, consoles, special assemblies, etc. Each drawing shall show all equipment with its manufacturer and model number.

d. Device Locations: Complete CAD-generated, 1/2" scale building floor plan detailing installation locations of all equipment, such as control panels, plug panels, equipment racks, speakers, etc. All conduit with cable quantities and types and all terminal block locations shall also be indicated.

e. Device Layout: Complete CAD-generated, 1/8" scale drawings detailing all device plates, plug panels, input/output panels, rack panels and custom components to be fabricated by the Contractor. Include the same details for all custom or nonstandard components to be furnished. Show all connectors, mounting devices and engraving detail on these drawings.

2. Prior to proceeding with respective portions of work:

a. Artwork, drawings, and listings indicating proposed nameplate nomenclature and arrangements for control panels, plug panels, and nameplates prior to fabrication.

b. Front panel layouts for all equipment racks, prior to installation, reflecting equipment to be used.

c. Diagrams for AC power low voltage control switching.

d. Details and descriptions of any other aspect of the system which differ from the contract drawings due to field conditions or due to the equipment furnished.

e. Submittal as otherwise noted on the drawings and/or as noted herein.

f. Approved shop drawings and instruction brochures, including schematic diagrams for all electronic devices, shall be present at the job site during the period set aside for system testing.

3. At Project Completion:

a. Record Drawings: Prior to Final Acceptance, provide three complete sets of drawings showing all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions.

b. Operation and Maintenance Manuals: Prior to Final Acceptance, provide three complete sets of Operation and Maintenance Manuals for the system. The Operation Manual shall contain all instruction necessary for the proper operation of the installed system and manufacturer's instruction. The Maintenance Manual shall contain all

"proof of performance" information as required in Part 3, and all manufacturers' maintenance information, and copies of non-priority computer programs and system setup disks documenting all programmable features for the installed system.

1.5 CONTRACTOR QUALIFICATIONS

A. The Contractor must be a contractor who has been regularly engaged in the furnishing and installation of commercial and industrial communications and clock systems and show evidence of successfully completing at least five (5) intercom projects of similar size and scope.

B. The Contractor shall demonstrate to the satisfaction of the Architect/Engineer/ Owner that it has:

1. Adequate plant and equipment to pursue the work properly and expeditiously.
2. Adequate staff and technical experience to implement the work.
3. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in the project.

C. The Contractor shall be bondable and shall hold a Class A Contractor's License which is accepted as valid within the State of Virginia.

D. Any contractor, who intends to bid on this work and does not meet the requirements of the "Contractor Qualifications" paragraph(s) above, shall employ the services of a contractor who does meet the requirements and who shall furnish the equipment, shop fabricate the equipment racks and subassemblies, make all connections to equipment and equipment racks, make all connections to remote controls and connection panels, and continuously supervise the installation and connections of all system cable and equipment.

E. A subcontractor so employed must be acceptable to the Architect/Engineer/Owner and shall be identified in the submittal.

1.6 QUALITY ASSURANCE

A. General: All equipment and materials required for installation under these Specifications shall be new and without blemish or defect.

B. Specific: Each major component of equipment shall have the manufacturer's name, address, and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be easily visible.

C. Substitutions:

1. It is not the intent of these Specifications to limit or restrict submission of proposals for products by other manufacturers but to set a baseline of operational performance and functions which all bidders must meet.

2. Where a specific piece of equipment has been discontinued and/or replaced by a new model, submission of the new model does not guarantee acceptance. Substitute items shall require evaluation by the Architect/ Engineer, or Owner prior to acceptance.
3. If substitute equipment is allowed even by an approved submittal, the Contractor shall be completely responsible for its use and for its ability to fulfill all intended functions in the completed systems. The Contractor shall replace all such equipment with equipment listed by type and model number in the Specifications if there is any evidence of equipment instability and/or incompatibility.
4. Any use of substitute equipment shall be at no extra cost to the Owner.
5. If a Bidder wishes to propose substitute equipment and/or a system to meet all the functional requirements of this Specification but deviates from the equipment or system specified herein, by individual components or entire design philosophy, he is encouraged to do so. To be considered, submit the information required by this Specification under "Submittals -Prior to proceeding with the work" for review by the Architect/Engineer/Owner.

PART 2 - PRODUCTS

2.1 EQUIPMENT SOURCE RESPONSIBILITY

A. Except where specifically noted otherwise, ALL equipment supplied for the system shall be the standard product of manufacturers of known reputation and experience in the industry.

2.2 INTERCOM AND PUBLIC ADDRESS

A. Each classroom shall be equipped with a flush-mounted ceiling speaker.

B. The intercom system shall be equipped with a minimum of four 2-way amplified communication paths to locations with speakers.

C. The system shall be able to call speaker rooms by dialing that number.

D. The system shall provide the capability of assigning speaker locations to any one or more of sixteen (16) software programmable paging zones, sixteen (16) program distribution zones, eight (8) security zones, or time signal zones. Assignment of zones shall be software controlled and shall be independent of each other. The installer shall demonstrate and train the faculty and staff on how to initiate changes to the (16) distribution zones, (8) security zones and signal zones. The system should also have the capability of silencing and one station at the head end cabinet. All exterior speakers shall be connected to one zone.

E. Distribution of emergency announcements and for the distribution of manually activated tones to all locations with speakers shall be provided from any authorized telephone.

F. Through programming and through switchbanks, it shall be possible to exclude selected speakers (such as all existing exterior speakers) from receiving paging

announcements. Provide a switch position for each classroom and office area shown on the plans.

G. Restricting the origination of emergency announcements, all page, zone page, and alarm signal from specific assigned telephones shall be provided through software programming of Owner's phone systems.

H. Program Distribution: The system shall distribute program material (music, radio broadcasts) in the following manner:

1. A tape-tuner unit shall be provided in the central control rack for cassette tape playback and AM/FM radio reception.
2. A compact disc player shall be provided in the central control rack.
3. A staff member shall "direct select" zones or areas to receive the program using a Standard DTMF multi-function phone with speed dials.
4. The speed dial buttons shall be labeled with clearly typed labels showing the zones.

I. Classroom and Corridor Speakers:

1. Provide a recessed round enclosure designed to accommodate 8" speaker/baffle assemblies. It shall be made of one-piece 22-gauge drawn steel with a rust-inhibiting coating, and an interior treated with a fire-retardant resonance damping material. The bottom inside of the backbox shall have a 9" pad of 3/8" thick acoustic foam to provide additional resonance and vibration control. Combination conduit knockouts for 1/2" and 3/4" shall be deeply scored, but not cut through, to preserve the leak-free integrity of the enclosure in air plenum installation.
2. Provide T-Bar bridge to support the speaker enclosure in all acoustical lay-in ceilings.
3. Provide a 8" permanent magnet, seamless cone-type speaker, with an additional cone provided to extend high-frequency response. Frequency range shall be 65 to 17,000 Hz. The ceramic magnet weight shall be at least 5 ounces. Axial sensitivity shall be 93 dB at 1 meter with 1 watt input. Power handling capacity shall be 8 watts RMS. Voice coil impedance shall be 8 ohms and shall measure 0.75" in diameter. The speaker shall be equipped with a universal line matching transformer for 25-volt output line tapped at 5/16, 5/8, 1-1/4, 2-1/2, and 5 watts.
4. Provide a flush-mount ceiling speaker baffle. It shall be constructed of 22-gauge cold-rolled steel, zinc-treated to prevent corrosion, and its one-piece design with deep-edge radius shall prevent rattling. The finish shall be white epoxy. It shall have four concealed welded studs for speaker mounting. The perforation pattern shall provide sound dispersion over the full width of the speaker cone.
5. Provide the quantity of assemblies shown on the plans.

L. Cables: Provide 22- or 24-gauge, twisted, solid, shielded pair telephone wire punched down on S66M blocks.

2.3 TELEPHONE COMMUNICATION

A. Provide four (4) ports of communication between the school intercommunication existing telephone switch.

2.4 MASTER CLOCK

A. The master control clock shall be microprocessor-based and programmable by the user through electronic means. A step-by-step guide shall be provided to enable the user to accomplish the programming easily and correctly. Master control clocks which are not microprocessor-based and/or which require a technician or programmer to perform the original programming and subsequent program changes shall not be acceptable.

B. The programmable master control clock shall be capable of storing in nonvolatile memory and controlling up to 500 events, such as ringing bells. It shall program and control:

1. The time at which the event is to occur and whether AM or PM.
2. The selection of any one zone or any combination of zones (up to 8), where the event is to occur.
3. Up to four schedules: "A", "B", "C", or "D" to permit flexible rearrangement of events to accommodate special circumstances.

C. The clock shall provide for the electronic selection of the following operational "modes":

1. "Time" — which shall permit the entry of "present" time display on the clock panel.
2. "Date" — which shall permit the entry of current date.
3. "Load" — which shall access entry of each element into the clock memory.
4. "Edit" — which shall permit the sequential display of all programs entered, for the purpose of review, correction, change, or deletion.
5. "Select" — which shall permit the activation of zones and schedules.
6. "Run" — which shall be the mode for normal operation.

D. The clock shall provide push buttons for accomplishing the programming which shall require no special skill or training to perform. Operation of these buttons shall insert into the clock memory, by following a simple set of step-by-step instructions, all of the elements required for programming an event, the time at which it is to occur, and whether AM or PM, the zone or zones in which it is to occur, the day or days on which each zone is to be active, the selection of up to four schedules required to accommodate normal or special circumstances. Once the programming for an event has been completed, the entire program shall be clearly displayed for review before it is entered into the memory.

E. The master control clock shall further provide:

1. Push buttons for manually controlling each zone, plus a separate push button for manually activating all zones simultaneously.
2. Push buttons for selecting "A", "B", "C", or "D" schedules.
3. Interface with secondary clocks, either analog or digital, with provision for hourly and 12-hour corrections.
4. Ability to program for automatic holiday operation.

5. Ability to program for required secondary clock correction.
6. Software selection of user zones (4, 6, or 8) or schedules.
7. Ability to program a combination of zones or schedules for each day.
8. Automatic Daylight Savings Time change, easily accomplished by user programming.
9. Display of the next scheduled event on the clock by pushing a single button.
10. A key lock to prevent tampering with the clock or making unauthorized program changes.
11. A 1—59-second programmable signal duration.
12. User programming of different duration for each zone.
13. A "Zero" duration programmable for latched operation.
14. Selection of 12-hour or 24-hour display format.
15. Provide a battery back-up for the system for two hours.

2.5 HEADEND RACK

A. Provide a single-bay, welded, multi-bay floor rack, for the system, the bay being at least 25" deep and having at least 77" of usable rack space. Provide rear doors and fill all unused rack space with blank panels.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform the work in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Provide all materials, devices, components, and equipment for complete operational systems.

C. Maintain a competent supervisor and supporting technical personnel, acceptable to the Owner, during the entire installation. Change of the supervisor during the project shall not be acceptable without prior written approval from the Architect/Engineer.

D. Coordinate all efforts with those of related trades. In the event of any conflicts, delayed, or improper preparatory work by others, notify the Architect/Engineer. The Architect's/Engineer's decision shall be binding. Verify all field conditions.

3.2 INSTALLATION OF SYSTEMS

A. Device Locations: Locate all apparatus requiring adjustments, cleaning, or similar attention so that it shall be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.
B. Blank and Custom Panels: Finish of blank panels and custom assembly panels shall match adjacent equipment panels as closely as possible.
C. Markings: Switches, connectors, jacks, receptacles, outlets, cables, and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched, or screened. Marking for these items are

purposely detailed on the drawings to ensure consistency and clarity. Verify any changes in working type size, and/or placement with the Owner prior to marking.

D. Environment: The equipment specified herein is designed to operate in environments of normal humidity, dust, and temperature. Protect equipment and related wiring during installation where extreme environmental conditions can occur.

E. Conduit: Review and coordinate conduit installation required for the system to ensure proper installation.

3.3 ELECTRICAL POWER

A. Grounding: Review and coordinate electrical power system installation, including grounding, to ensure proper operation of the system.

B. Verification: Verify that all AC power circuits designated for the system are properly wired, phased, and grounded. Report in writing any discrepancies found to the Division 26 Prime Contractor for corrective action.

C. Equipment Rack: Provide distribution of electrical power within the equipment racks with a minimum of two spare AC receptacles per branch circuit, used in the racks.

3.4 CLEANING

A. Clean all junction and terminal box interiors thoroughly before installing plates, panels, or covers.

3.5 WIRING METHODS AND PRACTICES

A. Identification: All wires shall be permanently identified at each wire end by marking with "E-Z" tape marker, or equivalent, identifying the classroom or space served using the final building room numbers.

B. Terminal Blocks: All terminal block connections shall be readily accessible. Not more than two wires connected to one terminal. Spare terminal blocks, equivalent to 10% of those in actual use, shall be provided.

C. Splicing: Splicing of cables shall not be permitted between terminations of specified equipment.

D. Pulling Cable: Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs. Do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation.

E. Cable Tie: Form in a neat and orderly manner all conductors in enclosures and boxes, wireways, and wiring troughs, providing circuit and conductor identification. Tie as required using T & B "Ty-Raps" (or equivalent) of appropriate size and type. Limit spacing between ties to 6" and provide circuit and conductor identification at least once in each enclosure.

F. Service Loops: Provide ample service loops at each termination so that plates, panels, and equipment can be demounted for service and inspection.

G. Wiring Harnesses:

1. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
2. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls, components, or terminations.

3.6 EQUIPMENT RACKS

A. General: The equipment racks shall be considered as custom assemblies and shall be assembled, wired, and tested in a properly equipped shop maintained by the Contractor. Assembly of racks on site shall not be permitted.

B. Equipment Location: Placement of equipment in equipment racks, as indicated in the drawings, is for maximum operator convenience. Verify any changes in placement prior to assembly. All system components and related wiring shall be located with due regard for the minimization of induced electromagnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience for the operator.

C. Rack Installation: Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.

D. Identification: All terminal blocks, rack-mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black or dark background that is similar to panel finish.

3.7 ACCEPTANCE TESTING

A. The Acceptance Testing will be witnessed by the Architect/Engineer. Coordinate this period so that free access, work lighting, and electrical power are available on the site.

B. Be prepared to verify the performance of any portion of the system by demonstration, listening, and viewing tests and instrumented measurements.

C. Make additional mechanical and electrical adjustments within the scope of work and which are deemed necessary by the Owner or Architect/Engineer as a result of the Acceptance Test.

3.8 SYSTEM DOCUMENTATION

A. Prior to Final Acceptance Tests, submit to the Owner three copies of an Operating and Maintenance Manual for the system that has been installed. These manuals

shall be used during the Final Acceptance Testing of the system. Each manual shall contain the following information:

1. Record drawings, including floor plans showing all device locations as well as elementary wiring and interconnection wiring diagrams (3 sets of each).
2. Copy of edited configuration files should be downloaded on disk and printed on hard copy paper given to School Plant for future editing and diagnostics.
3. Copy of dial-in numbers assigned to each phone in the building identified by the final building room numbers.
4. A copy of the software package required for the programming of the intercom system.

3.9 TRAINING

A. Provide a total of 8 hours of "Hands-On" training of faculty and staff of this school for the use and programming of the intercom and master clock systems.

END OF SECTION 275123

SECTION 311000 - SITE CLEARING

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.

B. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Virginia Erosion and Sediment Control Handbook 1992 (VSWC VESCH) applies to this section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 31200 "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

D. Burning: Will not be allowed on the site.

1.6 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Tree-Protection Zones: Protect according to requirements in VSWC VESCH and as indicated.

F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in VSWC VESCH and as indicated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of VSWC VESCH.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Protect trees remaining on-site according to requirements in VSWC VESCH and as indicated.

B. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is completed.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

C. Do not excavate within tree protection zones, unless otherwise indicated.

D. Where excavation for new construction is required within tree protection zones, excavate in accordance with the notes and details on the drawings.

E. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, and protect utilities indicated to remain in place.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 2 inches (50 mm) in diameter, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is not permitted.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

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.

B. Virginia Department of Transportation (VDOT), Road and Bridge Specifications (RBS), 2007 edition, applies to this section.

C. Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, Virginia Erosion and Sediment Control Handbook, 1992 (VSWC VESCH) applies to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade walks, pavements, turf and grasses and plants.
3. Preparing subgrades for building slabs.
4. Excavating and backfilling for buildings and structures.
5. Drainage course for concrete slabs-on-grade.
6. Subbase course for concrete pavements.
7. Base course for asphalt paving.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subgrade and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below base, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Blasting: Blasting is not allowed.

B. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

E. Use of Explosives: The use of explosives is not permitted.

F. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

G. Do not commence earth-moving operations until plant-protection measures specified in Section 311000 "Site Clearing" are in place.

H. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

I. Do not direct vehicle or equipment exhaust towards protection zones.

J. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; conform to VDOT RBS, Section 208, Size 21A.

E. Engineered Fill: Engineered Fill: Material shall consists of sand or gravel containing less than 25% by weight of fines, ASTM D 2487 Soil Classification Groups GW, GP, SW, SP, and SM, with no more than 25 percent passing the No. 200 sieve, with dimensions not to exceed 2 inches in diameter, having a liquid limit less than 20 and plastic limit less than 6, and should be free of rubble, organics, clay, debris, and other unsuitable material. Engineered fill shall be maintained within 2 percent of optimum moisture content at time of compaction. If fill soil of the required character does not exist at the site, it must be imported.

F. Bedding Course (Building slabs): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course (Pavements): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; conform to VDOT RBS, Section 203, coarse aggregate grading Size 57.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

I. Sand: ASTM C 33/C 33M; fine aggregate.

2.2 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:

   a. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
   b. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
   c. Tear Strength: 90 lbf (400 N); ASTM D 4533.
   d. Puncture Strength: 90 lbf (400 N); ASTM D 4833.

3. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.

4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

E. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Under the presence of the Owner's engaged geotechnical engineering testing agency, proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill voids with satisfactory soil while removing shoring and bracing.

D. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.
6. Under utility structures use bedding material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers. Do not compact with vibratory roller within 25 feet of the existing building. Use hand operated compaction equipment. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

B. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, base course under pavements and walks as follows:

1. Install separation geotextile, where indicated, on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subgrade under hot-mix asphalt pavement.
3. Shape base course to required crown elevations and cross-slope grades.
4. Place base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
2. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 313116 - TERMITE CONTROL

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. Soil treatment with termiticide.
2. Polymer barrier fittings with termiticide for installation around utility penetrations.

B. Related Sections:

1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 UNIT PRICES

A. Work of this Section is affected by unit price for additional polymer barrier fittings with termiticide at utility penetration(s).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.

1. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For termite control products, from manufacturer.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Polymer Barrier Fittings with Termiticide Application Report: After installation of polymer barrier fittings with termiticide is completed, submit report for Owner's records and include the following:

1. Plan drawing showing number and locations of each type of polymer barrier fitting with termiticide.
2. Termiticide brand name and manufacturer.
3. Schedule of inspections for one year from date of Substantial Completion.

E. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from single source.

D. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

C. Install polymer barrier fittings with termiticide around utility penetrations prior to pouring concrete and after installation and inspection of plumbing and

electrical pipes and conduits, slab vapor barrier, and concrete slab reinforcement.

1.8 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

B. Polymer Barrier Fittings with Termiticide Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of installation of polymer barrier fittings with termiticide, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat and repair or replace damage caused by termite infestation.

1. Warranty Period: Five years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation, Agricultural Products; Termidor.
b. Bayer Environmental Science; Premise 75.
c. FMC Corporation, Agricultural Products Group; Prevail.
d. Syngenta; Probuild TC.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

2.2 WOOD TREATMENT

A. Products: Subject to compliance with requirements, provide the following:

1. Syngenta; IMPASSE Termite Blockers.

B. Pipe/Conduit Fitting: Integral 2-1/2-inch- (65-mm-) long polymer sleeve and 1-inch- (25-mm-) wide circular flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.

C. Tub Trap Fitting: Integral polymer boot and 23-by-23-inch (585-by-585-mm) flange with lambda-cyhalothrin termiticide sealed between two outer polymer layers; with fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.5 INSTALLING POLYMER BARRIER FITTINGS

A. Remove any pipe wrap material so that the polymer barrier fittings can be applied directly to the pipe or conduit. After installing the barrier, reapply pipe wrap material both below and above the blocker to protect the pipe from contact with concrete.

B. Install polymer barrier fittings around each utility pipe and conduit penetrating concrete slab and foundation walls according to the EPA-Registered Label for the product and manufacturer's written instructions.

END OF SECTION 313116

SECTION 321216 - ASPHALT PAVING

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.

B. Virginia Department of Transportation (VDOT), Road and Bridge Specifications (RBS), 2007 edition, applies to this section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.

B. Related Requirements:

1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

B. Material Test Reports: For each paving material, by a qualified testing agency.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of VDOT RBS for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: VDOT RBS, Section 203.

C. Fine Aggregate: VDOT RBS, Section 202.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: VDOT RBS, Section 201.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.

B. Tack Coat: VDOT RBS, Section 310.

C. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Pavement Marking Paint: VDOT RBS, Sections 246 and 704, Type A, a fast drying water-based, non lead, acrylic resin paint.

1. Color: White, unless indicated otherwise.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: VDOT RBS, Section 211, Type BM-25.0 for materials and mix..
3. Surface Course: VDOT RBS, Section 211, Type SM 12.5A for materials and mix.
4. Mix Plant: VDOT RBS, Section 211.12.
5. Aggregate Base Course: See specification Section 312000, "Earthmoving".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements per specification Section 312000, "Earthmoving".

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section as indicated. Cut excavation faces vertically.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.

2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).

3.8 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

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SECTION 321313 - CONCRETE PAVING

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.

B. Virginia Department of Transportation (VDOT), Road and Bridge Specifications (RBS), 2007 edition, applies to this section.

C. Virginia Department of Transportation, (VDOT), Road and Bridge Standards (RBST), 2008 edition, applies to this section.

1.2 SUMMARY

A. Section Includes:

1. Driveways.
2. Curbs and gutters.
3. Walks.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Tactile Warning Tile: Submit samples with proposed color for approval by Architect.

B. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of detectable warnings ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Joint fillers.

C. Material Test Reports: For each of the following:

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for oil-based materials 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

B. Concrete Mix: VDOT RBS, Section 217, Class A4, General for materials and mix.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, [Class 3, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd. (305 g/sq. m)** dry] [or] [cotton mats].

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

2.6 DETECTABLE WARNING MATERIALS

A. Tactile Warning Tiles: Detectable warning surface shall be "tile" made of homogeneous glass and carbon, reinforced composite material or vitrified polymer composite (VPC) material with ultraviolet stabilized coating, to minimize color wear, and a "non-slip" surface, incorporating "truncated domes," made of same material. The normal thickness of the detectable warning tile shall be 1/8" exclusive of the height of the truncated domes. The tiles shall be in compliance with applicable Americans with Disabilities Act Accessibility Guidelines (ADAAG) and American with Disabilities Act (ADA) regulations with regard to warning surfaces. Color is typically "brick red", Federal Color No. 31136, or Federal Color No. 11302, for applications on standard concrete curb ramps. The color shall be integral with the detectable warning device tiles and shall not be surface applied. Paints or other surface coatings shall not be used. Product samples with proposed color shall be submitted to Architect for approval prior to installation.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete that complies with VDOT RBS, Class A4.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving as specified in Section 312000 "Earthmoving".

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

L. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 DETECTABLE WARNINGS

A. Tactile Warning Tiles: All work shall be in accordance with VDOT RBST, CG-12, Detectable Warning Surface.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Joint Spacing: 3 inches (75 mm).
5. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
6. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

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. Cold-applied joint sealants.
2. Joint-sealant backer materials.

B. Primers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of joint sealant and accessory.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1.6 FIELD CONDITIONS

A. 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 or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Virginia Department of Transportation (VDOT) Road and Bridge Specifications (RBS), 2007 edition, applies to this section.

C. Virginia Department of Transportation (VDOT), Road and Bridge Standards (RBST), 2008 edition, applies to this section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Cleanouts.
3. Catch basins.
4. Stormwater inlets.
5. Stormwater detention structures.
6. Stormwater treatment systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Catch basins stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
2. Stormwater Detention Structures: Include plans, elevations, sections, details.
3. Stormwater Treatment Systems: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design mix reports.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.2 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Tongue-and-groove ends and sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.
2. Class III, Wall B.

B. Reinforced Concrete Elliptical Stormdrain Pipe and Fittings: ASTM 507.

1. Tongue-and-groove ends and sealant joints with ASTM C990 bitumenor butyl-rubber sealant.
2. Class HE III.

2.3 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Inlet Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
2. Benches: Concrete, sloped to drain into channel.

2.5 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Comply with VDOT RBS and VDOT RBST.

2.6 STORMWATER INLETS

A. Curb Inlets: Comply with VDOT RBS and VDOT RBST.

2.7 STORMWATER DETENTION STRUCTURES

A. Injection molded plastic tank plates assembled to form a 95% void modular structure meeting all the requirements indicated on contract drawings.

2.8 STORMWATER TREATMENT SYSTEMS

A. Treatment systems shall be Standard Filterra System and Filterra Roof Drain System and shall be as indicated on the Contract drawings.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install catch basins for changes in direction.

D. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
3. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block as indicated. Set with tops 1 inch (25 mm) above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 CURB INLET INSTALLATION

A. Construct curb inlet to sizes and shapes inlet indicated.

B. Set frames and covers to elevations indicated.

3.7 STORMWATER DETENTION STRUCTURE INSTALLATION

A. Install in strict accordance with manufacturer's instructions.

3.8 STORMWATER TREATMENT SYSTEM INSTALLATION

A. Install in strict accordance with manufacturer's instructions.

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

3.10 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Damage: Crushed, broken, cracked, or otherwise damaged piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Leaks and loss in test pressure constitute defects that must be repaired.

C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100