PROJECT MANUAL FOR:

CUMBERLAND COUNTY MUSUEM OF PREHISTORY

884 YE GREATE ST
GREENWICH, NJ 08323

FOR:

Cumberland County Historical Society
PO Box 16
Greenwich, NJ 08323

ARCHITECT
Manders Merighi Portadin Farrell Architects, LLC
1138 East Chestnut Avenue #4
Vineland, NJ 08360

CIVIL ENGINEER
Fralinger Engineering
69 Shiloh Pike
Bridgeton, NJ 08302

MECHANICAL/PLUMBING/ELECTRICAL ENGINEER
Moore Consulting Engineers
457 Oakshade Road
Shamong, NJ 08088

Project Number 22.053

ARCHITECT

MANDERS MERIGHI PORTADIN FARRELL ARCHITECTS, LLC
1138 East Chestnut Avenue #4
Vineland, New Jersey 08360

Phone (856) 696-9155
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SECTION 010010 - INSTRUCTIONS TO BIDDERS

1.1 PROPOSALS:

A. The Cumberland County Historical Society invites proposals for all work in connection with the **Cumberland County Museum of Prehistory.**

B. Work for which Proposals are invited shall consist of one contract for General Construction.

C. Proposals will be received at the office of the Architect, Manders Merighi Portadin Farrell, 1138 East Chestnut Avenue #4, Vineland, NJ, Attention: Charles Ragonese; no later than **10:00 AM on Tuesday, February 11, 2025.**

D. Any bid prepared and submitted in accordance with the provisions described herein may be considered informal by the Owner, who reserves the right to waive any informalities in the bid or reject any and all bids, including alternate bids. No bidder shall withdraw a bid within thirty (30) days after the actual date of the opening thereof.

E. Bids are requested on the items stated in the Form of Proposal for the project. The prices should cover the cost of any nature incidental to and growing out of the work. In explanation, but not in limitation thereof, these costs shall include the cost of all work, labor, materials, equipment, transportation, and all else necessary to perform and complete the project in the manner and within the time required, all incidental expenses in connection therewith, all costs on account of loss by damage or destruction of the project, and any additional expenses for unforeseen difficulties encountered, for settlement of damages and for replacement of defective work and materials. Conditions, limitations or provisions attached to the proposal by the bidder may cause its rejection.

F. Before submitting their proposal, the bidder shall be familiar with the Drawings, Specifications, and other Documents that will form part of the Contract, shall have investigated in detail the sites of the project and shall have made such examination thereof, as may be necessary to satisfy themselves regarding the character and amount of work involved. They shall have satisfied themselves also that they can secure the necessary labor and equipment and that the materials they propose to use will comply with the requirements thereof and can be obtained by them in the quantities and at the time required.

G. Bidders are cautioned to carefully read the complete set of Drawings and Specifications to acquaint themselves with any requirements therein necessitating installation work by one Contractor of materials or equipment furnished by another Contractor or the Owner and required to complete the entire project.

H. Bids may be hand delivered to the office of the Architect, Manders Merighi Portadin Farrell, 1138 East Chestnut Avenue #4, Vineland, NJ, Attn: Charles Ragonese on the day the bids are to be received no earlier than one hour prior to the bid opening. Bids must be contained in an opaque sealed envelope clearly marked **"Bid for Cumberland County Museum of Prehistory.** Bidders are responsible for delivering their bids at the correct time and place.

Plans, specifications and bidding documents may be obtained from the Share File Site of Manders Merighi Portadin Farrell Architects, LLC, 1138 East Chestnut Avenue #4, Vineland, NJ (856) 696-9155.

Bids shall be made on the bid form provided in the specifications and in the manner prescribed in the Specifications and Instructions to Bidders.

I. Attention is directed to the fact that these Specifications include a complete set of Bidding and Contract forms. These are for the convenience of Bidders and are not to be detached from the Specifications, filled out, or executed. Separate copies of bid forms are furnished for that purpose. **Forms are at be provided in triplicate, two to be submitted with the bid and one to be retained by the bidder for their records. NOTE: All forms or papers required to be submitted with the bids shall be signed, witnessed, and/or sworn to in triplicate.**

J. When the proposal is made by an individual, their post office address and street address shall be stated, and they shall sign the proposal; when made by a corporation, company, partnership of other entity, its name and principal post office and street address shall be stated, and the proposals shall be signed by an authorized agent or officer. Before award is made to a bidder not a resident of the State, such bidder shall designate a proper agent in the State on whom service can be made in the event of litigation.

K. Contractor agrees to provide an Ownership Certificate on the form attached disclosing all equity owners with at least 10% ownership pursuant to N.J.S.A. 52:25-24.2.

1.2 CONSENT OF SURETY:

A. Pursuant to NJSA 18A:18A-25, Proposals shall be accompanied by a Consent of Surety in form as bound in these documents, assuring that satisfactory arrangements have been made between the surety and the Bidder by which surety agrees to furnish Bidder with a Performance and Payment bond and Maintenance Bond in form as bound herein. The Consent of Surety shall be executed by an approved surety company licensed to do business in the State of New Jersey for 100% of the work. The surety company shall be “A” rated or better by Bests.

1.3 POWER OF ATTORNEY:

A. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified copy of their Power of Attorney authorizing them to sign said bonds.

1.4 AWARD OF CONTRACT:

A. The Owner reserves the right to reject any or all bids, or to waive informality in the bidding, if it is in the interest of the Owner to do so.

B. The Bidder to whom the contract is awarded shall be required to execute said Contract within ten (10) days after notification of award of Contract to the Bidder.

1.5 FORM OF CONTRACT

A. The contract to be executed is the latest edition of AIA Document A101.

1.6 EXAMINATION OF SITE, DRAWINGS, ETC.:

A. Each Bidder shall visit the site of the proposed work and fully acquaint themself with the conditions as they exist so that they may fully understand the facilities, difficulties, and restrictions attending the execution of the work under this Contract. The bidder must certify by affidavit their compliance with site examination on the form included in this Project Manual.

B. Bidders shall also thoroughly examine and be familiar with the Drawings and Specifications. The failure or omission of any bidder to receive or examine any form, instrument or document, or to visit the site and acquaint themself with conditions there existing shall in no way relieve any bidder from obligation with respect to their bid or the Contract. By submitting a bid the bidder agrees and warrants that they have examined the site, the Drawings and Specifications and, where the Specifications require in any part of the work a given result to be produced, that the Specifications and Drawings are adequate and the required result can be produced under the Drawings and Specifications. No claim for any extra charge will be allowed because of alleged impossibilities in the production of the results specified or because of unintentional errors or conflicts in the Drawings and Specifications.

1.7 DRAWINGS AND SPECIFICATIONS:

A. The project shall be performed in accordance with the requirements of the Drawings and Specifications subject to modification as provided in General Conditions. The Drawings and Specifications are intended to complement and supplement each other.

B. Any work required by either of them and not by the other shall be performed even though omitted on others. Should any work be required which is not also denoted in the Specifications or on the Drawings because of an obvious omission, but which is, nevertheless, necessary for the proper completion of or performance of the project, such work shall be performed as fully as if it were described and delineated.

C. In the event of a conflict between the drawings, notes on the drawings and/or the specifications, please refer to the Supplementary General Conditions.

1.8 REVISIONS, ADDENDA & CLARIFICATIONS TO BID DOCUMENTS:

A. Should a bidder find during examination of the Drawings and Specifications, or after examination of the site, any discrepancies, omissions, ambiguities, or conflicts in or among the documents, or be in doubt as to their meaning, the Architect shall be notified not later than seven (7) days (Saturdays, Sundays and holidays excepted) before bid opening date, and where information sought is not clearly indicated or specified, the Architect will issue a written clarification to any person who has received a bid packet. The written clarification will then become part of the Bidding Documents.

1.9 INTERPRETATION OF CONTRACT DOCUMENTS:

A. No oral interpretation of the contract documents will be made to any bidder.

Every interpretation requested shall be made in writing to the Architect. No such request received within seven (7) days of the date established for the opening of bids will be given consideration.

B. Every interpretation and any supplemental instructions will be made in the form of an addendum to the contract documents, which, if issued, will be sent to all persons to whom contract documents have been issued by the Architect. Failure of the Architect to send or of any bidder to receive any such addendum shall not relieve any bidder from any obligation under their bid as submitted. All such addenda shall become a part of the contract documents.

1.10 SUBSTITUTIONS:

A. In the event a Contractor should propose a substitution for the specified equipment or materials, it shall be their responsibility to submit proof of equality, and to provide and pay for any tests which may be required by the Architect/Engineer, in order to evaluate such proposed substitution

B. Where any particular brand or manufactured article is specified, it shall be regarded as a standard. Similar products of other manufacturers, capable of equal performance and quality, in the opinion of the Architect will be accepted, if approved.

C. The application for approval of a substitution by the Contractor shall include the following information:

a. Identifying information shall be fully and completely furnished;

b. Note whether the item is included in Specifications; in which case, identify the Specification paragraph and section;

c. Attach data indicating in detail whether and how the substitution differs, if at all, from the article specified.

d. If a credit is to be offered for the substitution, a detailed itemization of the amount of credit must be shown.

e. If the proposed substitution involves a change in the scope of the Work of this or any other contractor or trade under the Contract Documents, then and in that event, the Contractor requesting approval undertakes and agrees to be responsible for any and all added costs and thereby involved by reason of the change in the work, the Work of other Contractors and trades, including redesign, if any;

f. An agreement by the Contractor to submit proof of equality and to have such tests performed at this own expense as may be required by the Architect;

g. No Contractor shall base his bid on substitutions which may have been approved on previous projects. Bids shall be based solely on Plans and Specifications of the subject project.

D. Since substitutions are primarily for the financial benefit of the Contractor, a credit change order shall accompany each request for substitution.

1.11 INDEMNIFICATION:

A. Bidders shall agree, if awarded a contract, that they will indemnify and save harmless the Owner from all suits and actions of every nature and description brought against it, growing out of that contract, or contracts, written or verbal, entered into between the Owner and the successful bidder, and further that upon the awarding of the

contract in accordance with these specifications, this agreement of indemnification shall automatically become effective.

1.12 COMPLIANCE WITH LAWS:

A. Contractor shall comply with all laws and regulations governing the project.

1.13 EXECUTION AND CONTRACT:

A. Subsequent of the award, the successful bidder shall execute and deliver to the Owner a properly executed Contract in such number of counterparts as the Owner may require.

B. See Section 000300 - Supplementary General Conditions for additional information.

1.14 CONSTRUCTION PERMITS:

A. Bidders shall include in their proposal the cost of all permits, fees and licenses for the proper execution and completion of the work, if applicable. See Section 010050 – Administrative Provisions for allowance pertaining to these costs.

END OF SECTION

CONTRACTOR_____

FORM OF PROPOSAL

Cumberland County Museum of Prehistory
884 Ye Greate St
Greenwich, NJ 08323

TO: **Cumberland County Historical Society**
PO Box 16
Greenwich, NJ 08323

Pursuant to and in compliance with your Advertisement, and the Instructions to Bidders, relating thereto, the undersigned hereby offers to furnish all plant, labor, materials, supplies, equipment and other facilities, and things necessary to or proper for, or incidental to, or required by the Plans and Specifications for the abovementioned project prepared by:

Manders Merighi Portadin Farrell Architects, LLC
1138 East Chestnut Avenue #4
Vineland, New Jersey 08360
(856) 696-9155

And all Addenda issued by the Owner and mailed to the undersigned prior to that date of opening of Bids whether received by the undersigned or not, and to guarantee said addition as required by the Contract Documents.

CONTRACT NO. 1 - GENERAL CONSTRUCTION

I (We) propose to fully execute and complete all work under CONTRACT NO. 1 - GENERAL CONSTRUCTION to include all work required by these Documents for the total sum of:

_____($_____)

ALTERNATE NO. 1 – EXISTING BUILDING ROOF

Deduct all work associated with existing building roof replacement as indicated in Section 010300 Alternates and referenced throughout the contract drawings and specifications.

_____($_____)

ALTERNATE NO. 2 – HEAVY TIMBER FRAME ROOF

Replace the heavy timber roof structure with conventional wood framing as indicated in Section 010300 Alternates and referenced throughout the contract drawings and specifications.

_____($_____)

Total number of working days required for construction

_____( ) working days

The date of substantial completion is defined as the date when construction is sufficiently completed, in accordance with the Contract Documents, as modified by any Change Orders agreed to by the parties so that the Owner can occupy the project for the intended use.

By submission of this Bid, each Bidder certifies, and in the case of a joint Bid each party thereto certifies as to its own organization, that this Bid has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this Bid with any other Bidder or with any competitor.

Bidder agrees to include in the Base Bid the stipulated sum specified as a Contingency Allowance as specified in Section 010050.

Bidder agrees to include in the Base Bid the stipulated sum specified as a Permit Allowance as specified in Section 010050.

Bidder hereby agrees to commence Work under this contract on or before a date to be specified in the NOTICE TO PROCEED.

THEREFORE, in exchange for the Owner's promise to examine and consider this proposal as set forth in the Information to Bidders, the Bidder hereby promises:

1. That they will not withdraw, recall, revoke, or otherwise act to nullify this Proposal in any manner within 60 consecutive days after the date of opening the Proposals;
2. That, if the Owner shall accept this proposal, the Bidder will sign the Contract Agreement within 10 days after notification that the documents are ready for their signature.

The Bidder acknowledges the receipt of all addenda and clarifications relating to this project and has confirmed with the office of the Architect the receipt of all said documents.

This bid may be withdrawn in writing at any time prior to the scheduled time for the opening of bids or any authorized postponement thereof.

The undersigned hereby designates at his office to which notice of acceptance may be mailed, telegraphed or delivered, as the following:

Company Name:_____

Contact Person:_____

Street Address: _____

City:_____

Telephone Number: _____

DATE:_____ BY:_____
(signature)

_____
(title)

_____
(firm's name) * (Seal)

Seal
(If Bid is by a Corporation)

_____
(street address)

_____
(city and zip code)

*If a Corporation, give State of Incorporation, using the phrase: “A Corporation organized under the Laws of the State _____."
“

*If a Limited Liability Corporation, give the names of the “Members” trading and doing business under the firm name and style of _____."

*If a Partnership, give the names of the Partners, using also the phrase: "Co-Partners" trading and doing business under the firm name and style of _____."

*If an Individual using a trade name, give the individual name using also the phrase: "An individual doing business under the firm name and style of _____."

****

** In compliance with N.J.S.A. 52:25-24.2, the Contractor shall supply the names and addresses of all equity owners who own ten (10%) percent or more of the Contractor's business or company.

OWNERSHIP CERTIFICATE

In compliance with N.J.S.A. 52:25-24.2, the Contractor shall supply the names and addresses of all equity owners who own ten (10%) percent or more of the Contractor's business or company.

A. Name of Company _____

B. Type of Business Yes No

1. Individual
2. Partnership
3. Corporation
4. Other (Specify)

C. Names and Addresses of Equity Owners owning ten (10%) percent or greater:

_____

_____

_____

_____

Person Completing Form _____

Official Position _____

Date _____

Signature _____

NOTE: NO BID WILL BE AWARDED UNLESS THE ABOVE STATUTE IS COMPLIED WITH.

NON-COLLUSION CERTIFICATION

The undersigned bidder hereby specifically certifies that, to the best of their knowledge and belief, the annexed bid proposal for the above named project has not been prepared in collusion with any other bidder or like item or service and that the prices, discounts, terms and conditions thereof have not been directly or indirectly communicated by or on behalf of said bidder so any such person other than the recipient of such bid will not be communicated to any such person prior to the official opening of said bid.

Bidder fully understands that no premiums, rebates, or gratuities are permitted either with, prior to, or after signing of contract. Any such violation will result in cancellation and the removal from the bid list.

The undersigned bidder further certifies that they have the necessary authority to sign this stipulation stating they have not entered into any agreement or otherwise taken any action in restraint of free competitive bidding in connection with above named project.

This certification may be treated for all purposes as a sworn statement made under oath as equivalent affirmation and subject to the provisions of N.J.S.A. 2C:23-1 through N.J.S.A. 2C:23-3, inclusive and relevant sequential sections, and if applicable, 13 U.S.C. 1001, et seq.

Signature:_____
(Type or print name as signed above)

Position:_____

Company:_____

Dated:_____

CERTIFICATE OF SITE VISIT

CUMBERLAND COUNTY MUSEUM OF PREHISTORY
884 Ye Greate St
Greenwich, NJ 08323

PROJECT NUMBER 22.053

The undersigned hereby certifies that _____
(Person Inspecting Job Site)

inspected the job site for _____ on
(Company Name)

_____ and we are fully aware of any existing conditions and we are acquainted with the site.
(Date)

_____
Signature

LIST OF SUBCONTRACTORS

A. Carpentry Work:
   1. Name _____
   2. Address_____

B. Drywall Work:
   1. Name _____
   2. Address_____

C. Painting:
   1. Name _____
   2. Address_____

D. Plumbing and Gas Fitting Work:
   1. Name _____
   2. Address_____

E. HVAC Work:
   1. Name _____
   2. Address_____

F. Electrical Work:
   1. Name _____
   2. Address_____

G. Heavy Timber Framing:
   1. Name _____
   2. Address_____

H. Precast Concrete:
   1. Name _____
   2. Address_____

I. Casework: _____
   1. Name _____
   2. Address_____

J. Ceramic Tile:
   1. Name _____
   2. Address_____

BID CHECK LIST

(The items that are listed below are to be completed, executed and returned with your bid)

1. Contractor's Proposal. _____

2. Contractor's Ownership Certification _____

3. Non-Collusion Certification _____

4. Certificate of Site Visit _____

5. List of Subcontractors _____

END OF SECTION

PART 1 - GENERAL

1.1 BID FORMS

A. Contractor’s Proposal

B. Ownership Certification

C. Certificate of Site Visit

D. List of Subcontractors

1.2 FORMS TO BE SUBMITTED BY THE SUCCESSFUL BIDDER:

A. Standard Form of Agreement Between Owner and Contractor (AIA Document A101).

B. Certificate of Insurance (AIA Document G705).

C. Application & Certificate for Payment (AIA Document G702 and G703).

1.3 PROJECT CLOSE OUT FORMS:

A. Certificate of Substantial Completion (AIA Document G704).

B. Contractor's Affidavit of Payment of Debts and Claims (AIA Document G706).

C. Contractor's Affidavit of Release of Liens (AIA Document G706A).

D. Consent of Surety Company to Final Payment (AIA Document G707).

E. Maintenance Bond

1.4 GENERAL CONDITIONS

A. The General Conditions of the Contract for Construction (A.I.A. Document A.201, Fourteenth Edition, dated 2017) as published by the American Institute of Architects are a part of the Contract Documents and shall apply to all Contractors, separate Contractors and/or Subcontractors.

END OF SECTION

SECTION 000300 - SUPPLEMENTARY GENERAL CONDITIONS

PART 1 The General Conditions of the Contract for Construction (AIA. Document A201, dated 2017) as published by the American Institute of Architects and as herein modified and supplemented are a part of the Contract Documents and shall apply to all Contractors, separate Contractors and/or Subcontractors.

These conditions supplement and/or amend the General Conditions. To the extent of any conflict between the General Conditions and the Supplementary General Conditions the later shall control.

1.1 INSURANCE REQUIREMENTS:

A. The Contractor shall provide and pay for insurance coverage of such types and in such amounts as will completely protect the Contractor and the Owner against any and all risks of loss or liability arising out of this contract.

B. The insurance must be furnished by insurance companies with an "A" or better rating, as published in the most recent edition of Bests Insurance Key Rating Guide and authorized to do business in the State of New Jersey.

C. The Contractor shall furnish the Owner with Certificates of Insurance naming the Owner as an additional insured, and providing further that the liability insurance coverage shall be considered as primary and not as excess insurance, describing the types and amounts of insurance, identifying the coverage to this contract by reference and providing for thirty (30) days written notice to the Owner by registered mail prior to any modification, cancellation, non-renewal or other change in coverage.

D. The Contractors and all Subcontractors, Comprehensive General Liability Insurance shall be in the following amounts, and at their own expense:

1. Workman's Compensation as required by all applicable Federal, State, Maritime, or other laws including Employer's Liability with a limit of at least: $100,000.00.

2. Comprehensive General Liability (including Premises-Operations; Independent Contractors' Protective Products, and Completed Operations; Broad Form Property Damage):

    a. Bodily Injury and Property Damage: Single Limits: $1,000,000.00
    b. Property Damage Liability Insurance shall include coverage for the following hazards:
        1. X (Explosion)
        2. C (Collapse)
        3. U (Underground)
    c. Contractor's Liability (Hold Harmless Coverage) shall be included in limits stated above.

3. Completed Operations and Products Liability shall be maintained for two (2) years after final payment and Certificates of Insurance shall continue to be applied to Owner.

4. Comprehensive Automobile Liability including non-ownership coverage as well as owned vehicles:

Bodily Injury and Property Damage:
Single Limits: $1,000,000.00

E. In addition, the Owner will carry the following kinds of insurance at its own expense:

1. Owner's Contingent Liability:
Bodily Injury, Each Occurrence: $1,000,000.00
Property Damage, Aggregate: $1,000,000.00

2. The Owner will be responsible for procuring and maintaining BUILDERS RISK Insurance.

1.2 BUILDERS' RISK INSURANCE:

A. The Owner shall provide and pay for Builders' Risk Insurance.

1.3 PROGRESS PAYMENTS AND RETAINER

A. The Owner will make progress payments to the contractor on a monthly basis in accordance with Article 9 of AIA Document A201, General Conditions to the Contract for Construction.

B. Progress payments for stored materials will be made only when the location of stored materials is provided in writing by the Contractor along with receipts for said material and insurance certificate for the material wherever stored. Liability for stored material whether stored on or off site, will be the responsibility of the Contractor.

C. Ownership of all materials stored or on site shall be with the Owner but Contractor shall be responsible for caring for and insuring such materials until they are permanently incorporated into the project. Owner may, at Owner's option, insure materials before they are incorporated into the project.

D. In making such monthly payments, Five (5%) percent of the amount due on each partial payment shall be withheld when the outstanding balance of the contract exceeds $500,000 and five (5%) percent of the amount due on each partial payment shall be withheld when the outstanding balance of the contract is $500,000 or less.

1.4 CHANGE ORDERS

A. The allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the following schedule:
1. For the Contractor, for any Work performed by the Contractor's own forces, ten percent (10%),
2 For the Contractor, for Work performed by his Subcontractor, five percent (5%) of the amount due the Subcontractor.
3. For each Subcontractor or Sub-subcontractor involved, for any Work performed by that Subcontractor's own forces, ten percent (10%) of the cost.
4. For each Subcontractor, for Work performed by his Sub-subcontractors, five percent (5%) of the amount due the Sub-subcontractors.

1.5 OBSERVANCE OF LAWS:

A. The Contractor shall observe and comply with all Federal, State and local laws and regulations that affect those engaged or employed in this project, the materials and/or the conduct of the work.

B. All such laws and regulations and/or ordinances affecting this Contract in any way shall be part of the Contract as if included herein.

C. The specifications, notice to bidders, instructions to bidders, Drawings and all contract documents, including the bid and the contract as awarded, shall be construed to be in accordance with the laws of the State of New Jersey.

1.6 SPECIFICATIONS:

A. The titles to the Divisions of these Specifications are introduced merely for convenience and are not necessarily a correct segregation of labor or materials. Such separations shall not operate to make the Architect an arbiter to establish limits between the General Contractor and Subcontractor.

B. The Contractor shall classify and allocate the furnishing of materials and the performance of work to the various trades in accordance with local customs, jurisdictional awards, regulations and decisions insofar as they are applicable.

C. The Contractor for General Construction and all subcontractors shall conduct all their operations on this project in such a manner that no jurisdictional disputes arise regarding unloading, handling, installations, and connections of the various items in the several trades involved.

1.7 INTERPRETATIONS:

A. Should the Specifications and/or Drawings disagree in themselves or with each other, the better quality or quantity of work shall be provided.

B. Large scale details shall govern small scale Drawings.

C. Where the work is indicated in detail on only a portion of a drawing, this work shall apply to other like portions of the area of work.

D. Should any work be necessary for the proper execution of the Specifications or Drawings, the Contractor shall perform all such work as if fully specified or indicated.

E. The Architect shall be advised in writing of all discrepancies, errors, conflicts, and omissions in the Specifications and Drawings. The Architect will promptly resolve the matter. Any work undertaken after the discrepancy has been discovered and prior to clarification by the Architect will be done at the Contractor's risk.

F. The Architect shall decide as to the meaning or intention of any portion of the Specifications and Drawings. His decision shall be final.

G. Throughout the Specifications and Drawings, references are made to nominal, not actual, sizes of commercial materials. In all such cases, Contractor shall supply materials in their commercial sizes in accordance with recognized and accepted standards as intended. Only if accurately dimensioned, or if particularly specified, will sizes other than usual commercial sizes by required.

1.8 LONG LEAD ITEMS

A. Contractor shall submit a list of all materials, equipment or components which are anticipated to require more than four weeks delivery, together with scheduled ordering and delivery timetable. This will be discussed and reviewed regularly at the job site meetings. Upon request by the Architect, the Contractors shall be prepared to produce evidence of having placed orders for specific materials, equipment and components.

1.9 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship installed and/or performed under this Contract to be free of defects which may impair the strength, durability or appearance of said work and/or may make it unsuitable for the intended purpose, for a period of one (1) year from the date of final completion, unless otherwise noted in the other sections of this Specification.

B. The Contractor shall repair and/or replace any such work to the satisfaction of the Owner at no additional cost to the Owner.

C. This guarantee is in addition to and shall in no way limit any other warranty or guarantee required by the provisions of the Contract Documents.

1.10 PERMITS AND REGULATIONS

A. Permits and licenses necessary for the prosecution of the Work shall be secured and paid for by the Contractor.

B. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the Drawings and Specifications are at variance therewith, he shall promptly notify the Architect in writing. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Architect, he shall bear all costs arising therefrom.

1.11 REQUIRED PROVISIONS DEEMED INSERTED:

A. Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein and the Contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party the Contract shall forthwith by physically amended to make such insertion or correction.

1.12 SUSPENSION OF WORK / NO DAMAGES FOR DELAY:

A. Should the Owner be prevented or enjoined from proceeding with work or from authorizing its prosecution either before or after its prosecution, for any reason, the Contractor shall not be entitled to make or assert a claim for damage by reason of said delay, but time for completion of the work will be extended to such reasonable time as the Owner may determine will compensate for time lost by such delay with such determination to be set forth in writing.

1.13 TIME OF COMPLETION

A. Work, including the procurement of permits and processing of required submittals, shall be started within five (5) days of the date of the Notice to Proceed which is the date of the Owner-Contractor Agreement for this work unless otherwise agreed to by the Owner and Contractor.

B. The date of substantial completion is defined as the date when construction is sufficiently completed, in accordance with the Contract Documents, as modified by any Change Order agreed to by the parties so that the Owner can occupy the project for the intended use.

C. The Contractor and the Owner agree, that the date of beginning and the time for completion as specified in the Contract of work to be done hereunder are essential conditions of this Contract and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on the date to be specified in the Notice to Proceed.

D. All changes to the contract (change orders) must include any change in completion date if required, otherwise changes will not be a reason to extend the completion date.

END OF SECTION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Regulatory Requirements.

B. Access to Site and Use of Premises.

C. Security Procedures.

D. Applications for Payments.

E. Reference Standards.

F. Allowances.

G. Owner Furnished Products.

H. Contract Method.

I. Coordination.

1.2 REGULATORY REQUIREMENTS

A. The following regulations are applicable to this project:
   1. New Jersey Uniform Construction Code (Latest Edition).
   2. International Building Code, New Jersey 2021 Edition.

B. Other regulations may also be applicable.

C. Submit copies of all permits, licenses and similar permissions obtained, and receipts for fees paid, to the Owner directly.

1.3 SECURITY PROCEDURES

A. Limit access to the site to persons involved in the work.

B. Provide secure storage for materials for which the owner has made payment and which are stored on site.

C. Secure completed work as required to prevent loss.

1.4 APPLICATIONS FOR PAYMENT

A. Preparation of Applications for payment: Complete form entirely.
   1. Make current application consistent with previous applications, certificates for payment and payments made.
   2. Base application on current schedule of values and contractor’s construction schedule.

3. Include amounts of modifications issued before the end of the construction period covered by the applications.
4. Include signature by person authorized by the contractor to sign legal documents.
5. Notarize each copy.
6. Submit three (3) copies to the Architect, plus one (1) additional copy to the Architect's Consultants as required.
7. Attach waivers of lien.
8. Attach current, updated schedule of values.

1.5 REFERENCE STANDARDS

A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The date of the standard is that in effect as of the Bid date, or date of Owner-Contractor Agreement when there are no bids, except when a specific date is specified.

1.6 ALLOWANCES

A. Permits and Fees – Provide an allowance of twenty thousand ($20,000.00) dollars for the cost of all building permits, utility permits and fees of governing agencies.

B. Contingency Allowance – Include in the contract for construction the sum of fifty thousand ($50,000.00) dollars for use upon the Owner's instructions as a contingency allowance for incidental work not covered under the contract.

C. All work relating to allowances shall be performed as directed in the field.

1.7 OWNER FURNISHED PRODUCTS

A. Products furnished and installed by Tenant/Owner:
1. Telephones/Computers. (Wiring and devices to be a part of the Base Bid).
2. Security systems.
3. Moveable furnishings including chairs, desks, etc.
4. Appliances.
5. Room Identification Signage (Toilet Room Signage is to be a part of the Base Bid).

B. Contractor shall make provisions to coordinate their work with the work to be performed by the Owner.

1.8 CONTRACT METHOD

A. Construct the Work under a single lump sum contract.

B. Items noted "NIC" (Not in Contract) will be furnished and installed by Owner.

1.9 COORDINATION

A. Coordinate work of the various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items installed later.

B. Coordinate space requirements and installation of mechanical and electrical work. Follow routing shown for pipes, ducts, and conduits, as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

END OF SECTION

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Identification and description of Alternate work.

1.2 RELATED REQUIREMENTS

A. Bid Documents: Quotation of cost of each Alternate.

B. Owner-Contractor Agreement: Alternates accepted by Owner for incorporation into the work.

1.3 PROCEDURES

A. Alternates will be exercised at the option of the Owner.

B. Coordinate related work and modify surrounding work as required to complete the Work, including changes under each Alternate, when acceptance is designated in Owner-Contractor Agreement.

1.4 ALTERNATE NO. 1 EXISTING BUILDING ROOF

A. Deduct all material and labor required to furnish and install a metal roof over the existing garage building.

1.5 ALTERNATE NO. 2 TIMBER FRAME ROOF

A. Replace the heavy timber frame roof construction with conventional wood framing.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Preconstruction meeting.

C. Progress meetings.

D. Pre-installation meetings.

1.2 RELATED SECTIONS

A. Division 1 - Project Coordination: Coordination with Owner/Architect.

1.3 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

C. The submission and coordination of accurate shop drawings, actual execution of the work, temporary health and safety protective measures, protection of work completed, means and methods, and supplying of adequate labor to complete the project by the deadline is the responsibility of the Contractor.

D. The Architect will check each shop drawing submitted to determine whether it complies with the intent of the Contract Documents and the design. This same requirement is placed on the Contractor and their supplier.

E. It is the intention of the Contract Documents to place various materials of construction and related requirements in their proper place both on the Drawings and in the specifications. However, no guarantee is made that such locations are, in every instance, where the Contractor might expect to find them.

F. The Contractor is required to provide, or make available, all Contract Documents to each vendor and subcontractor, both prior to bid to ensure proper Proposals, and during construction to ensure compliance with the intent of the Contract Documents. This is the sole responsibility of the Contractor.

G. The Architect is not responsible for project coordination between various subcontractors, which is the responsibility of the Contractor. The Architect will observe, by attendance at regularly scheduled job meetings, the orderly flow and progress of the work. The various subcontractors and those people responsible to them are required to interact with each other to ensure that the work progresses in an orderly fashion and without exceeding the time allotted in the Contract.

H. The Contractor is responsible for reading all the Specifications and following the various Contract Drawings. The Contractor's review of all the Contract Documents as well as shop drawings, coordination drawings and other information required to complete the project is their sole responsibility. The Contractor shall request clarification on any matters where ambiguities might exist, to receive instruction as to the proper documents to follow.

I. All products or materials which require the selection of color finishes are to be submitted early and with sufficient lead time to permit the Owner to select the desired color. Delays in submitting such product or material samples or color charts at one time may delay the selection process and prevent the Contractor from granting suppliers final releases for fabrication.

1.4 PRECONSTRUCTION MEETING

A. Owner/Architect will schedule a meeting after Notice of Award.

B. Attendance Required: Owner, Construction Manager, Architect, and General Contractor.

C. Agenda:
1. Review Scope of Work.
2. Designation of personnel representing the parties in Contract and the Architect.
3. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
4. Scheduling.

1.5 PROGRESS MEETINGS

A. The Construction Manager shall preside over meetings throughout the progress of the Work at maximum bi-weekly intervals.

B. The General Contractor will arrange for meetings, prepare an agenda with copies to participants, and prepare meeting minutes for review by the Construction Manager.

C. The General Contractor shall coordinate Pre-Installation meetings referenced in this Section.

D. Attendance Required: Job superintendent, Owner, Construction Manager, Architect, and major subcontractors and suppliers as appropriate to agenda topics for each meeting.

E. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

F. General Contractor will record minutes and distribute copies within 2 days after meeting to participants, with 1 copy to Architect, Owner, participants, and those affected by decisions made.

1.6 PRE-INSTALLATION MEETING

A. When required in individual specification sections, convene a pre-installation meeting at the site prior to commencing work of the section. Mock-up/samples are to be finished prior to meeting.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify the Architect one (1) day in advance of the meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation, and installation procedures.
   2. Review coordination with related work.
   3. Review mock-up/samples.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittals schedule.
2. Submittal procedures.
3. Submittal processing.
4. Proposed products list.
5. Action submittals.
6. Informational submittals.

1.2 SUBMITTALS SCHEDULE

A. Submit list of submittals with expected submittal dates. Coordinate with dates for start of related construction shown in the construction progress schedule.

B. Transmit submittals schedule electronically to Architect not later than date of first application for payment.

1. No submittals will be reviewed until the initial submittals schedule is received.
2. Revise submittals schedule as directed by Architect.
3. Revise submittals schedule to be current with construction progress schedule revisions.

C. Submittals Schedule: Provide the following information in tabular format with separate line items for each required type of submittal.

1. Specification section number and title.
2. Name of subcontractor.
3. Description of Work covered by submittals.
4. Submittal type: action or informational.
5. Scheduled date for first submittal.
6. Scheduled date for Architect's final release or approval.

1.3 SUBMITTAL PROCEDURES

A. Transmit submittals with AIA Form G810.

B. Sequentially number transmittal forms. Number revised submittals with original number and sequential alpha numeric suffix.

Example	072100.01-PD FSK Batt Insulation where:
072100	Specification section number
.01	Submittal sequence number
(-01-01)	Sheet number - Revision number (only if required)
-PD	Type of Submittal: SD - Shop Drawings or Submittal Document PD - Product Data SDS - MSDS Sheets SMP - Sample(s)
DESC.	Text description of submitted item.

C. Assemble submittals to show:

1. Project, Contractor, Subcontractor, and supplier identification.
2. Pertinent drawing and detail number, and specification section number.
3. Space for Contractor and Architect review stamps on first page.
4. Variations from Contract Documents highlighted.
5. Product and system limitations potentially detrimental to Work highlighted.
6. Changes since previous submission.

D. Apply stamp and sign or initial certifying that review, approval, verification of required products, field dimensions, adjacent Work, and information coordination is per Work and Contract Documents.

E. Schedule submittals to expedite Project. Coordinate submission of related items for simultaneous submittal.

1. Submit action submittals and informational submittals for each Specification Section under separate transmittal.
2. Submit sustainable design submittals separately from other submittals.

F. Submit one native, editable PDF electronic file for each required submittal to Architect.

1. Page Size: 8-1/2 x 11 inches minimum; 30 x 42 inches maximum.
2. Submit PDF sample identification with image of each physical sample.
3. Bookmark PDF drawing files showing sheet numbers and titles.
4. Bookmark PDF product files showing product names and data types.
5. Annotated PDF electronic file will be returned to Contractor.

G. Distribute reviewed submittals to affected parties.

1. Instruct parties to promptly report inability to comply with requirements.

1.4 SUBMITTAL PROCESSING

A. Allow 15 days for each initial submittal review.

1. Allow sufficient submittal, resubmittal and review time to avoid delaying Work.
2. When intermediate submittal is necessary, process as for initial submittal.

B. Architect will promptly notify Contractor when:

1. Submittal processing must be delayed for coordination with other submittals.
2. Additional information is required to process the submittal.

C. Contract Time extension is not permitted from failing to make submittals sufficiently in advance of Work to permit processing.

1.5 PROPOSED PRODUCTS LIST

A. Submit initial proposed products list within 15 days after Notice to Proceed.

1. After review by Owner and Architect, resubmit list within 10 days.

B. Submit a revised list with each Application for Payment until all required products are identified.

C. Indicate major products from each specification section, with name of manufacturer, trade name, and model number.

1. Identify proposed products that are specified proprietary products.

D. When proposed products are one of the specified proprietary products identified by manufacturer, and model number, additional submittals for that product are not required except as follows:

1. Shop drawings are required for products specially fabricated to size or configuration to comply with project conditions.
2. Samples are required for products where color, texture, finish, pattern and other selections are required.

E. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 ACTION SUBMITTALS

A. Submit action submittals for Architect's approval for conformance with Contract Documents.

1. Provide additional information or clarification upon Architect request.
2. Action submittals will be returned with Architect's stamp indicating submittal status.
3. Maintain one set of Architect approved submittals at Project site for Architect's reference.

B. Product Data:

1. Clearly mark data files indicating applicable products, models, options, and other data.
2. Supplement manufacturer standard data with Project specific information.
3. When requested or specified, submit color charts or sample kits for initial color selections.

a. Include full range of manufacturer standard colors, textures, and patterns.
b. Include custom colors and other product characteristics where specified.

4. Indicate product utility and electrical characteristics.

a. Show utility connection types, sizes and locations.
b. Show maintenance and service access locations.

5. Do not include Safety Data Sheets (SDS) in submittals.

a. When requested by Owner, submit SDS directly to Owner.

C. Shop Drawings:

1. Show product specific Project construction, including sizes, configurations, and details.
2. Show product connections and anchorages to adjacent systems and building structure.

a. Indicate location and magnitude of loads transferred to building structural systems.

3. Show terminations and interface with adjacent systems and materials.
4. Indicate product utility and electrical characteristics.

a. Show utility connection types, sizes and locations.
b. Show maintenance and service access locations and required clearances.

5. Identify required tolerances for successful installation.
6. Identify required and actual field measurements necessary for fabrication.

D. Samples:

1. Submit three samples, unless a greater number is specified in individual Specification sections.

a. Attach printed PDF submittal transmittal and sample image to each sample.

2. Show Project specific aesthetic, color, and finish selections.
3. Show functional and aesthetic characteristics of the product, with integral parts and attachment devices.
4. Submit samples for interfacing work at same time where aesthetic selection coordination is required.
5. One sample will be retained by Architect. Remaining samples will be returned.
6. Maintain one approved sample at Project site for Architect's reference.

1.7 INFORMATIONAL SUBMITTALS

A. Submit informational submittals for Architect's knowledge and for limited purpose of assessing conformance with Contract Documents.

1. Provide additional information or clarification upon Architect request.
2. Informational submittals will not be returned unless rejected for not complying with requirements.
3. Maintain one set of submittals at Project site for Architect's reference.

B. Certificates: Prepared by manufacturer or independent third party attesting to product compliance with Contract Documents.

1. Submit supporting reference data, affidavits, and certifications.
2. Certificates may be recent or previous test results acceptable to Architect.

C. Delegated Design Submittals:

1. Shop drawings and calculations, signed and sealed by licensed professional responsible for designing Work shown on approved shop drawings.

a. Submit in quantity and form suitable for submission to and approval by authority having jurisdiction.
b. Revise submittal and provide additional information when required by authority having jurisdiction.

2. Submit certificate of professional liability insurance from licensed professional responsible for design.

D. Test and Evaluation Reports: Independent testing agency reports attesting to product compliance with Contract Documents.

E. Source Quality Control Submittals: Shop test reports attesting to product compliance with Contract Documents.

F. Field Quality Control Submittals: Field test reports attesting to product compliance with Contract Documents.

G. Manufacturer Reports: Field inspection reports recording outcome of site observation.

1. Submit report within five days of site observation.

H. Special Procedure Submittals: Describe perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

I. Qualification Statements: Manufacturer, fabricator, and installer statements, quality manuals, and credentials showing compliance per Contract Documents.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quality Assurance
2. Quality control and control of installation.
3. Delegated design services.
4. Tolerances.
5. References.
6. Labeling.
7. Mockups.
8. Field samples.
9. Testing and inspecting services.
10. Manufacturer field services.
11. Test reports and certifications.

1.2 REFERENCES

A. Definitions:

1. Experienced: An entity or individual who successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project, with a three year record of successful performance, and familiar with special requirements of product, assembly, project, and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Experienced firms with sufficient production capacity to produce units required.
2. Fabricators and Finish Applicators: Experienced firms with sufficient production capacity to produce units required.
3. Installers: Experienced firms or individuals with sufficient manpower to produce work required.
4. Testing Agencies: Experienced firms with sufficient capacity and necessary equipment to perform tests required, complying with one of the following programs.

    a. A nationally recognized testing laboratory per 29 CFR 1910.7.
    b. Accredited agency per NIST's National Voluntary Laboratory Accreditation Program.

5. Licensed Professionals: Experienced individuals, licensed or otherwise legally qualified to practice in the jurisdiction where the Project is located.

1.4 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with specified reference standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

C. Measure in-place construction as needed for fabrication and execution. No changes to Contract Sum or Contract Time will be allowed for differences between Drawing dimensions and field measurements where no measurements were performed.

1.5 DELEGATED DESIGN SERVICES

A. Where delegated design is specified, comply with specified performance and design criteria.

1. If criteria are not sufficient, submit RFI for needed criteria.

1.6 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturer tolerances. When manufacturer tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.7 REFERENCE STANDARDS

A. Abbreviations and Acronyms: Names of trade associations, standards generating organizations, governing authorities, and other entities are frequently referred to in Contract Documents by acronyms and abbreviations. Request explanation of unknown terms from Architect.

B. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

C. Follow reference standards by date of issue current on date of Contract Documents, except where specific edition date is required by code.

D. Where specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

E. Provisions within cited reference standards changing Owner, Architect, and Contractor duties and responsibilities from contractual requirements are void.

1.8 LABELING

A. Attach labels from agencies approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include approved agency identification on each label. Install products with labels visible. Include:

1. Manufacturer name.
2. Model number.
3. Serial number.
4. Performance characteristics.

1.9 MOCKUPS

A. Definition:

1. Mockups are constructed to demonstrate materials and workmanship for review by Architect.

B. Construct mockups at Project site in locations acceptable to Architect unless laboratory mockups are specified.

C. Construct mockups in compliance with applicable Specification sections.

1. Design and construct foundations, supports, framing, and bracing for freestanding mockups.

D. Photograph construction to record concealed conditions per requirements of Section 013200. Make photographs available to Architect and Owner when requested.

E. Mockups are subject to testing specified for constituent products.

F. Approved mockups establish work results standard.

G. Protect mockups against damage until removal is authorized.

H. Mockups may remain as part of the Work only when so designated in individual Specification sections.

1.10 FIELD SAMPLES

A. Definition:

1. Field Samples are assemblies constructed to demonstrate materials and workmanship for review by Architect.

a. Construct field samples in final locations in sizes described in technical Specifications sections.

B. Construct field samples in compliance with applicable Specification sections.

C. Approved field samples establish work results standard.

D. Protect field samples against damage until Substantial Completion.

E. Approved, undamaged field samples may remain as part of the Work unless designated in individual Specification sections.

1.11 TESTING AND INSPECTION SERVICES

A. Except where specified as Owner responsibility, employ and pay for specified services of an independent firm to perform testing and inspections.

1. Owner testing and inspecting agencies will be identified to Contractor.
2. Copies of reports prepared by Owner testing and inspecting agencies will be sent to Contractor.

B. Include dates for agency testing and inspecting in Progress Schedule and provide minimum 10 days prior notice to agencies.

1. Provide access to the Work as requested by testing and inspecting agencies.
2. Provide samples of materials, design mixes, equipment, tools, storage for samples, and assistance by incidental labor requested by agency.

C. Testing and employment of testing and inspecting agencies shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Retest and reinspect defective Work when required by Architect. Cost for retests and re-inspections will be charged to Contractor.

E. Limits on testing and inspecting agencies:

1. Agency does not have authority to release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency does not have authority to approve or accept any portion of Work.
3. Agency may not assume duties of Contractor.
4. Agency does not have authority to stop Work.

1.12 MANUFACTURER FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe and provide instructions when necessary for acceptable:

1. Installation conditions.
2. Workmanship quality.
3. Equipment start-up.
4. Equipment test, adjust, and balance.

B. Submit qualifications of observer to Architect 14 days, minimum, in advance of required observations.

C. Report observations and site decisions or instructions that are supplemental or contrary to contract documents or manufacturers' written instructions.

D. Submit written inspection reports per Section 013300.

1.13 TEST REPORTS AND CERTIFICATIONS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide test reports and manufacturer certifications.

B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Submittals may be recent or previous test results on material or Product, as acceptable to Architect.

D. Submit reports and certifications per Section 013300.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Utilities: Electricity, water and sanitary facilities.

B. Temporary Controls: Barriers and protection of the work.

C. Construction Facilities: Progress cleaning.

D. Security.

E. Project Identification.

1.2 RELATED SECTIONS

A. Section 01700 - Contract Closeout: Final Cleaning.

1.3 ENUMERATION OF TEMPORARY FACILITIES AND SERVICES

A. The contractor shall provide and pay for the following, as specified in this Section, for the use of the contractor and the subcontractors:

1. Access Roads and Coordination of location of construction facilities provided by other contractors.
2. Dust control services.
3. Existing property protection.
4. Ice and snow removal.
5. Other employee protection facilities required by law.
6. Project identification sign.
7. Public protective facilities required by law.
8. Waste disposal service.
9. Temporary heat.
10. Water supply.
11. Electrical service.
12. Temporary lighting.

1.4 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

1.5 PROTECTION OF INSTALLED WORK

A. Protect installed work and project special protection where specified in individual specification Sections.

1.6 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition.

B. Remove waste materials, debris and rubbish from site periodically. Use of Owner's dumpsters and containers will not be permitted.

1.7 PROJECT IDENTIFICATION

A. Provide a 8 x 4 foot Project identification sign of wood frame and exterior plywood construction, painted, with exhibit lettering by professional sign painter, to Architect's design and colors. List title of Project, name of Owner, Architect and Engineers. Sign to include a rendering of the building's exterior to be provided by the Architect.

B. Erect on site at a location established by Architect and in compliance with local municipal codes.

PART 2 - PRODUCTS

2.1 TEMPORARY WATER SERVICE

A. Temporary Water Service:

1. Provide water adequate for demand of construction operations. Contractor shall pay for water used.
2. Do not use permanent piping system to distribute non-potable water.

2.2 TEMPORARY ELECTRICITY

A. Temporary Power:

1. Provide electricity adequate for demand of construction operations. The contractor shall pay costs of energy used.
2. Electrical service:

    a. Obtain temporary service.
    b. Provide disconnect at connection to service.
    c. Provide service conductors and equipment.
    d. Minimum power characteristics: 240/120 volt, single phase.

3. Temporary Lighting: Provide at least the lighting required by law; two (2) watts per square foot minimum. Other required special lighting to be provided by each prime contractor.

2.3 HEAT/VENTILATION

A. Provide as required to maintain specified conditions for construction operations, to protect materials and finishes from damage due to temperature or humidity. No temporary electrical heat to be used unless approved by Owner.

2.4 SANITARY FACILITIES

A. Provide and maintain required sanitary facilities and enclosures.

END OF SECTION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Products.

B. Transportation and Handling.

C. Storage and Protection.

D. Product Options.

E. Products List.

F. Substitutions.

G. Systems Demonstration.

1.2 PRODUCTS

A. Products include material, equipment, and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a Specification section shall be the same and shall be interchangeable.

1.3 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged conditions in manufacturer's unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

1.4 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. Arrange storage to provide access for inspection. Periodically inspect to ensure products are undamaged and are maintained under required conditions.

C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.

B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not specifically named.

C. Products Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications: No options, no substitutions allowed.

D. Products Specified by Naming Only One Manufacturer: No options, no substitutions allowed.

1.6 PRODUCTS LIST

A. Within fifteen (15) days after the date of Owner-Contractor agreement, submit a complete list of major products proposed for use, with name of manufacturer, trade name and model number of each product.

1.7 SUBSTITUTIONS

A. Only within 15 days after the date of Owner-Contractor Agreement will Architect consider requests from Contractor for substitutions. Subsequently, substitutions will be considered only when a product becomes unavailable due to no fault of Contractor.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

C. Request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
2. Will provide the same warranty for substitution as for specified product.
3. Will coordinate installation and make other changes which may be required for Work to be complete in all respects.
4. Waives claims for additional costs which may subsequently become apparent.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written requests, or when acceptance will require substantial revision of Contract Documents.

E. Architect/Engineer will determine acceptability of proposed substitution and will notify Contractor of acceptance or rejection in writing within a reasonable time.

F. Only one request for substitution will be considered for each product. When substitution is not accepted, provide specified product.

1.8 SYSTEMS DEMONSTRATION

A. Prior to final inspection, demonstrate operation of each system to Architect and Owner.

B. Instruct Owner's personnel in operation, adjustment and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction.

END OF SECTION

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. Closeout Procedures.

B. Final Cleaning.

C. Adjusting

D. Operation and Maintenance Data.

E. Warranties.

F. Spare Parts and Maintenance Materials.

1.2 CLOSEOUT PROCEDURES

A. When Contractor considers Work has reached final completion, submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's inspection.

B. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

C. The architect will issue a final change order reflecting approved adjustments to contract sum not previously made by change order.

1.3 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment. Clean or replace filters of mechanical equipment. Clean roofs and drainage systems.

C. Clean site; sweep paved areas, rake clean other surfaces effected by work.

D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

1.4 ADJUSTING

A. Adjust operating Products and Equipment to ensure smooth and unhindered operation.

1.5 OPERATION AND MAINTENANCE DATA

A. Provide data for:

1. Mechanical Equipment and Controls - Division 23.

1.6 WARRANTIES

A. Provide duplicate, notarized copies. Execute Contractor's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers.

B. Submit material prior to final application for payment. For equipment put into use with Owner's permission during construction, submit within 10 days after first operation. For items of Work delayed materially beyond Date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.7 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each Section, in addition to that used for construction of Work. Coordinate with Owner, deliver to Project site and obtain receipt prior to final payment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Protection of existing trees indicated to remain.
2. Removal of trees and other vegetation.
3. Topsoil stripping.
4. Clearing and grubbing.
5. Removing above-grade improvements.
6. Removing below-grade improvements.

1.3 PROJECT CONDITIONS

A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner's property.
2. Restore damaged improvements to their original condition, as acceptable to property owners.

C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
2. Provide protection for roots over 1-1/2 inch (38 mm) in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Architect. Employ a licensed arborist to repair damage to trees and shrubs.
4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

1.4 EXISTING SERVICES

A. General: Indicated locations are approximate; determine exact locations before commencing Work.

B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this Work.

C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SITE CLEARING

A. General: Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches (100 mm). Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches (50 mm) in diameter, and without weeds, roots, and other objectionable material.

1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.

a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.

2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.
3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.

C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.

1. Completely remove stumps, roots, and other debris protruding through ground surface.
2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

a. Place fill material in horizontal layers not exceeding 6 inches (150 mm) loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.

3.2 DISPOSAL OF WASTE MATERIALS

A. Burning on Owner's Property: Burning is not permitted on Owner's property.

B. Removal from Owner's Property: Remove waste materials from Owner's property.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Preparing and grading subgrades for slabs-on-grade, walks, pavements, and landscaping.
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for slabs-on-grade.
4. Subbase course for walks and pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 2 Section "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
2. Geotechnical Report – The recommendations of this report govern the preparation of the site at the building pad and paved areas.

1.3 DEFINITIONS

A. Excavation consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.

E. Base Course: The layer placed between the subbase and surface pavement in a paving system.

F. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.

G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

I. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for the following: (Not Applicable)

C. Samples of the following:

1. 20 lb (9 kg) samples, sealed in air-tight containers, of each proposed fill and backfill soil material from on-site or borrow sources.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: The Contractor will have a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; 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 Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.

D. Backfill and Fill Materials: Satisfactory soil materials.

E. Subbase and Base Material: Dense graded aggregate base course or soil aggregate base course. Designation I-5 conforming to NJDOT specifications.

F. Engineered Fill: Subbase or base materials.

G. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2 inch (38 mm) sieve and not more than 5 percent passing a No. 8 (2.36 mm) sieve.

H. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2 inch (38 mm) sieve and 0 to 5 percent passing a No. 50 (300 micrometer) sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

B. Detectable 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 minimum, 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.

1. Tape Colors: Provide tape colors to utilities as follows:

a. Red: Electric.
b. Yellow: Gas, oil, steam, and dangerous materials.
c. Orange: Telephone and other communications.
d. Blue: Water systems.
e. Green: Sewer systems.

C. Filter Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.

1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:

a. Grab Tensile Strength (ASTM D 4632): 100 lb (45 kg).
b. Apparent Opening Size (ASTM D 4751): #100 U.S. Standard (150 micrometer) sieve.
c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft. (102 L/s per sq. m).

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 earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Tree protection is specified in the Division 2 Section "Site Clearing."

3.2 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.3 EXCAVATION

A. Explosives: Do not use explosives.

B. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

3.4 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.

1. For pipes or conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, 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 circumference. Fill depressions with tamped sand backfill.

3. Where encountering rock or another unyielding bearing surface, carry trench excavation 6 inches (150 mm) below invert elevation to receive bedding course.

3.7 APPROVAL OF SUBGRADE

A. Notify Architect, Engineer and testing agency when excavations have reached required subgrade.

B. When testing agency determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.

B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.

3.10 BACKFILL

A. Backfill excavations promptly, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Testing, inspecting, and approval of underground utilities.
4. Concrete formwork removal.
5. Removal of trash and debris from excavation.
6. Removal of temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

C. Coordinate backfilling with utilities testing.

D. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

E. Place and compact final backfill of satisfactory soil material to final subgrade.

F. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.12 FILL

A. Fill in accordance with the Geotechnical Report.

B. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.

C. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

D. Place fill material in layers to required elevations for each location listed below.

1. Under grass, use satisfactory excavated or borrow soil material.
2. Under walks and pavements, use subbase or base material, or satisfactory excavated or borrow soil material.
3. Under steps and ramps, use subbase material.
4. Under building slabs, in accordance with the Geotechnical Report.
5. Under footings and foundations, in accordance with the Geotechnical Report.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.

a. Stockpile or spread and dry removed wet satisfactory soil material.

3.14 COMPACTION

A. Place backfill and fill materials in layers in strict accordance with the Geotechnical Report.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1.2 inches (30 mm).
2. Walks: Plus or minus 1.2 inches (30 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.

3.16 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course material on prepared subgrades. Place base course material over subbases to pavements.

1. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
2. Shape subbase and base to required crown elevations and cross-slope grades.
3. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
4. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders at least 12 inches (300 mm) wide of acceptable soil materials and compact simultaneously with each subbase and base layer.

3.17 DRAINAGE FILL

A. Under slabs-on-grade, place drainage fill course on prepared subgrade.

1. Compact drainage fill to required cross sections and thickness.
2. When compacted thickness of drainage fill is 6 inches (150 mm) or less, place materials in a single layer.
3. When compacted thickness of drainage fill exceeds 6 inches (150 mm) thick place materials in equal layers, with no layer more than 6 inches (150 mm) thick nor less than 3 inches (75 mm) thick when compacted.

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3.18 FIELD QUALITY CONTROL

A. Testing Agency Services: Contractor will engage a testing agency to inspect Earthwork. Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas at the direction of the Owner. Stockpile or spread soil on site as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

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 soil treatment for termite control.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data and application instructions.

C. Certification that products used comply with U.S. Environmental Protection Agency (EPA) regulations for termiticides.

1.4 QUALITY ASSURANCE

A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for preparing substrate and application.

B. Engage a professional pest control operator who is licensed according to regulations of governing authorities to apply soil treatment solution.

C. Use only termiticides that bear a federal registration number of the EPA and are approved by local authorities having jurisdiction.

1.5 JOB CONDITIONS

A. Restrictions: Do not apply soil treatment solution until excavating, filling, and grading operations are completed, except as otherwise required in construction operations.

B. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

1.6 WARRANTY

A. Warranty: Furnish written warranty, executed by Applicator and Contractor, certifying that applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.

B. Warranty Period: 5 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 SOIL TREATMENT SOLUTION

A. General: Use an emulsible, concentrated termiticide that dilutes with water, specially formulated to prevent termites infestation. Fuel oil will not be permitted as a diluent. Provide a solution consisting of one of following chemical elements.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

C. Products: Subject to compliance with requirements, provide one of the following:

1. Chloropyrifos:
   a. Dursban TC, Dow Chemical Co.
   b. or approved equal.

D. Dilute with water to concentration level recommended by manufacturer.

E. Other solutions may be used as recommended by Applicator if approved for intended application by local authorities having jurisdiction. Use only soil treatment solutions that are not harmful to plants.

PART 3 - EXECUTION

3.1 APPLICATION

A. Surface Preparation: Remove foreign matter 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 foundations. Toxicants may be applied before placing compacted fill under slabs if recommended by toxicant manufacturer.

B. Application Rates: Apply soil treatment solution per manufacturer's recommendations for site and application.

1. At hollow masonry foundations or grade beams, treat voids at rate of 2 gallons per 10 linear feet (2.6 L per meter), poured directly into the hollow spaces.
2. At expansion joints, control joints, and areas where slabs will be penetrated, apply at rate of 4 gallons per 10 linear feet (5.1 L per linear m) of penetration.

C. Post signs in areas of application to warn workers that soil termiticide treatment has been applied. Remove signs after areas are covered by other construction.

D. Reapply soil treatment solution to areas disturbed by subsequent excavation, landscape grading, or other construction activities following application.

END OF SECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt overlays.
4. Pavement-marking paint.

B. Related Sections include the following:

1. Section 02200 – Earthwork: Aggregate subbase and base courses and aggregate pavement shoulders.
2. Section 07900 - Joint Sealers: Joint sealants and fillers at paving terminations.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the standard specifications of the New Jersey Department of Transportation.

1. Standard Specification: As indicated.
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Job-Mix Designs: For each job mix proposed for the Work.

D. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate dedicated handicapped spaces with international graphics symbol.

E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

G. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

1. Firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which Project is located.

C. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.

D. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 – General Requirements: Project Meetings, review methods and procedures related to asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

F. Testing Agency Qualifications: Demonstrate to Architect’s satisfaction, based on Architect’s evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.5 deg C).
2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

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 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: Sound; angular crushed stone; crushed gravel; or properly cured, crushed blast-furnace slag; complying with ASTM D 692.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone; gravel, properly cured blast-furnace slag, or combinations thereof; complying with ASTM D 1073.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.

B. Asphalt Cement: ASTM D 3381 for viscosity-graded material.

C. Undersealing Asphalt: ASTM D 3141, pumping consistency.

D. Prime Coat: ASTM D 2027; medium-curing cutback asphalt; MC-30, MC-70, or MC-250.

E. Prime Coat: Asphalt emulsion prime conforming to state DOT requirements.

F. Prime Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

H. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

I. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Sand: ASTM D 1073, Grade Nos. 2 or 3.

B. Pavement-Marking Paint: Alkyd-resin type, ready-mixed, complying with FS TT-P-115, Type I, or AASHTO M-248, Type N.

C. Pavement-Marking Paint: Latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952.
1. Color: As indicated.

2.4 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; 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: As indicated.
3. Surface Course: As indicated.

B. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Provide mixes complying with the composition, grading, and tolerance requirements of ASTM D 3515 for the following nominal, maximum aggregate sizes:

a. Base Course: 1 inch (25 mm).
b. Surface Course: 1/2 inch (13 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.2 COLD MILLING

A. Clean existing paving surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement, inlcuding hot-mix asphaly and, as necessary, unbound-aggregate base course, by cold milling to grades and cross sections indicated.
   1. Repair or replace curbs, manholes, and other construction damaged during cold milling.

3.3 PATCHING AND REPAIRS

A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.

   1. Tack coat faces of excavation and allow to cure before paving.
   2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
   3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

B. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.

   1. Allow tack coat to cure undisturbed before paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 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.

   1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to 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 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, except where 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. Complete asphalt base course for a section 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.

3.6 JOINTS

A. Construct joints to ensure 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.
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 by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook."
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.

3.7 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 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: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and rerolling to required elevations.

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 ASTM D 1559, but not less than 94 percent nor 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 nor 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 still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected 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.

3.8 INSTALLATION TOLERANCES

A. 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. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to cure for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D 979.

1. Reference laboratory density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 1559, and compacted according to job-mix specifications.

2. Reference maximum theoretical density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
3. 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, but in no case will fewer than 3 cores be 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.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

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 exterior portland cement concrete paving for the following:

1. Miscellaneous pads and items.
2. Curbs and gutters.
3. Walkways.
4. Driveway aprons.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 2 Section "Earthwork" for subgrade preparation, grading and subbase course.
2. Division 2 Section "Pavement Joint Sealants" for joint fillers and sealants within concrete paving and at joints with adjacent construction

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, dry-shake finish materials, and others if requested by Architect.

C. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

D. Laboratory test reports for evaluation of concrete materials and mix design tests.

E. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.

1.4 QUALITY ASSURANCE

A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 318, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a 100-foot or less radius.

B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 775 with ASTM A 615, Grade 60 deformed steel bars.

C. Plain, Cold-Drawn Steel Wire: ASTM A 82.

D. Welded Steel Wire Fabric: ASTM A 185. Furnish in flat sheets, not rolls, unless otherwise acceptable to Engineer.

E. Deformed-Steel Welded Wire Fabric: ASTM A 497.

F. Fabricated Bar Mats: Welded or clip-assembled steel bar mats, ASTM A 184. Use ASTM A 615, Grade 60 steel bars, unless otherwise indicated.

G. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

H. Epoxy-Coated Joint Dowel Bars: ASTM A 775 with ASTM A 615, Grade 60 plain steel bars.

I. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.

1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33, Class 4, and as follows. Provide aggregates from a single source.

1. Maximum Aggregate Size: 1-1/2 inches.
2. Do not use fine or coarse aggregates that contain substances that cause spalling.
3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

D. Water: Potable.

E. Fiber Reinforcement: Synthetic fibers engineered and designed for secondary reinforcement of concrete slabs, complying with ASTM C 1116, Type III.

2.4 ADMIXTURES

A. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

G. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

H. Products: Subject to compliance with requirements, provide one of the following:

1. Air-Entraining Admixture:

    a. Air-Tite or Amex 210; Cormix Construction Chemicals.
    b. Sealtight AEA; W.R. Meadows, Inc.
    c. Sika AER; Sika Corp.
    d. or approved equal.

2. Water-Reducing Admixture:

    a. Chemtard; ChemMasters Corp.
    b. Type A Series; Cormix Construction Chemicals.
    c. Eucon WR-75; Euclid Chemical Co.
    d. or approved equal.

3. High-Range Water-Reducing Admixture:

    a. Super P; Anti-Hydro Co., Inc.
    b. Cormix 2000, PSI Super, or Melmet; Cormix Construction Chemicals.
    c. Eucon 37; Euclid Chemical Co.
    d. or approved equal.

4. Water-Reducing and Accelerating Admixture:

    a. Q-Set; Conspec Marketing & Manufacturing Co.
    b. Gilco Accelerator or Lub NCA; Cormix Construction Chemicals.

c. Accelguard 80; Euclid Chemical Co.
d. or approved equal.

5. Water-Reducing and Retarding Admixture:

a. Type D Series; Cormix Construction Chemicals.
b. Eucon Retarder 75; Euclid Chemical Co.
c. Daratard-17; W.R. Grace & Co.
d. or approved equal.

2.5 CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2. Clear Waterborne Membrane-Forming Curing Compound:

a. Clear Cure Water Base; Anti-Hydro Co., Inc.
b. Spartan Cote WB; The Burke Co.
c. W.B. Resin Cure; Conspec Marketing and Mfg. Co.
d. or approved equal.

2.6 RELATED MATERIALS

A. Boiled Linseed Oil Mixture: Combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.

B. Traffic Paint: Alkyd-resin ready-mixed, complying with AASHTO M 248, Type S.

1. Color: White.

C. Nonslip Aggregate Finish: Fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, nonglazing, and unaffected by freezing, moisture, and cleaning materials.

D. Dry-Shake Color Hardener: Packaged dry combination of materials consisting of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground nonfading mineral oxides interground with cement. Color as selected by Architect from manufacturers' standards, unless indicated otherwise.

E. Bonding Agent: Acrylic or styrene butadiene.

F. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.

2.7 CONCRETE MIX

A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28-Day): 4000 psi.
2. Maximum Water-Cement Ratio at Point of Placement: 0.45.
3. Slump Limit at Point of Placement: 3 inches.

a. Slump limit for concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus or minus 1-1/2 percent:

1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
2. Air Content: 6.0 percent for 1-inch maximum aggregate.
3. Air Content: 6.0 percent for 3/4-inch maximum aggregate.
4. Air Content: 7.0 percent for 1/2-inch maximum aggregate.
5. Air Content: 2.5 to 4.5 percent.

D. Fiber Reinforcement: Add to mix at rate of 1.5 lb per cu. yd., unless manufacturer recommends otherwise.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.

1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (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 SURFACE PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork and screeds for grade and alignment to following tolerances:

1. Top of Forms: Not more than 1/8 inch in 10 feet.
2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.3 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for 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 fabric 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.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.4 JOINTS

A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.

1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.

B. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as shown on Drawings. Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:

1. Tooled Joints: Form contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
2. Inserts: Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.

C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete.
2. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
3. Provide tie bars at sides of paving strips where indicated.
4. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

D. Isolation Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless indicated otherwise.
2. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
4. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcing before placing concrete. Do not place concrete on surfaces that are frozen.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.

E. 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.

1. When concrete placing is interrupted for more than 1/2 hour, place a construction joint.

F. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.

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 reinforcing, dowels, and joint devices.

H. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.

I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.

J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.

K. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

L. Cold-Weather Placement: Comply with provisions of ACI 306R 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 air temperature has fallen to or is expected to fall below 40 deg F (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 accepted in mix designs.

M. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled 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. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. Float Finish: Begin floating when bleed water sheen has disappeared and the 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 within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
3. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

4. Radius: 1/4 inch.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.

B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. 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 7 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 a 12-inch 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, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during 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 directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 FIELD QUALITY CONTROL TESTING

A. The Contractor will employ a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

   a. Slump:
   b. Air Content:
   c. Concrete Temperature:
   d. Compression Test Specimens:
   e. Compressive-Strength Tests:

B. Additional Tests: The testing agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.9 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete 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 concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 028210 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vinyl coated fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts
4. Manual gates and related hardware.
5. Temporary fencing.

1.2 SPECIFICATIONS TO BE USED

A. The 2007 Standard Specifications for Road and Bridge Construction of the New Jersey Department of Transportation as amended, shall govern the construction of this project.

B. The New Jersey Department of Transportation Standard Construction Details shall govern except insofar as same are modified or change in drawings prepared especially for this particular project.

1.3 REFERENCES

A. American Society for Testing and Materials:
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
4. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
5. ASTM A569/A569M - Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality.
6. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
7. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
8. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
9. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
10. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
11. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
12. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
13. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
14. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

B. Chain Link Fence Manufacturers Institute:
1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Permanent Fence Height: 8 feet nominal, vinyl coated wire.
B. Temporary Fence Height: 8 feet nominal, no coating of wire required.

C. Line Post Spacing: At intervals not exceeding 10 feet.

D. Fence Post and Rail Strength: Conform to ASTM F1043 Light Industrial Fence quality.

1.5 SUBMITTALS

A. Under provisions of Division 1 - General Requirements - Submittals: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 CLOSEOUT SUBMITTALS

A. Under provisions of Division 1 - General Requirements: Contract Closeout.

B. Operation and Maintenance Data: Procedures for submittals.

1.7 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum two years documented experience.

1.9 DELIVERY, STORAGE AND HANDLING

A. Under provisions of Division 1 - General Requirements: Storage and Protection.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer’s name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Anchor Fence Inc..
2. Merchants Metals.
3. Page - Wilson Corporation.
4. Or Approved Equal.

2.2 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI Product Manual.

B. Fabric Size: CLFMI Light Industrial.

C. Intermediate Posts: Type I round or square.

D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round or square.

2.3 COMPONENTS

A. Line Posts: 1.9 inch diameter.

B. Corner and Terminal Posts: 2.38 inch.

C. Gate Posts: 2.875 inch diameter.

D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.

E. Gate Frame: 1.66 inch diameter for fittings and truss rod fabrication.

F. Fabric: 2 inch diamond mesh interwoven wire, 9 gage thick (wire gauge), top salvage knuckle end closed, bottom selvage knuckle end closed, vinyl coated, black finish.

G. Tension Wire: 6 gage thick steel, single strand.

H. Tie Wire: Aluminum alloy steel wire.

I. Temporary Fence Fabric: 11 gauge thick, standard finish.

2.4 ACCESSORIES

A. Caps: Cast steel galvanized or Galvanized pressed steel; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Gate Hardware: Fork latch with gravity drop; two 180 degree gate hinges for each leaf.

D. Privacy Slats: Vinyl strips, flat configuration, sized to fit fabric weave, color as selected.

2.5 GATES

A. General:
   1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
   2. Factory assemble gates.
   3. Conform to requirements specified for PVC coated steel chain link fence except that PVC coated aluminum alloy framing conforming to ASTM B429 may be used.
   4. Design gates for operation by one person.

B. Swing Gates:
   1. Fabricate gates to permit 180 degree swing.
   2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.6 FINISHES

A. Components and Fabric: Vinyl coating, black color in accordance with ASTM F934 over coating of 1.8 oz/sq ft galvanizing.

B. Vinyl Components: color to match fabric.

C. Hardware: Galvanized to ASTM A153/A153M, 1.8 oz/sq ft coating.

D. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set all posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Line Post Footing Depth Below Finish Grade: ASTM F567.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Install top rail through line post tops and splice with 6 inch long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 28 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.

K. Position bottom of fabric 2 inches above finished grade.

L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.

M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

N. Install bottom tension wire stretched taut between terminal posts.

O. Install gate with fabric to match fence. Install three hinges on each gate leaf, latch, catches, retainer and locking clamp.

P. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

Q. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

R. Extend concrete footings 1 in (25 mm) above grade, and trowel, forming crown to shed water.

S. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From Indicated Position: 3 inch.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Fine grading and preparing lawn areas.
2. Furnishing and applying new topsoil.
3. Furnishing and applying soil amendments.
4. Furnishing and applying fertilizers.
5. Seeding new lawns.
6. Replanting unsatisfactory or damaged lawns.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 2 Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.
2. Division 2 Section "Earthwork" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for the following:

1. Seed Mix.
2. Fertilizers.

C. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful grass establishment. Require Installer to maintain an experienced full-time supervisor on the Project site during times that grass planting is in progress.

B. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

1.6 COORDINATION AND SCHEDULING

A. Planting Season: Sow lawn seed and install sod during normal planting seasons for type of lawn work required. Correlate planting with specified maintenance periods to provide required maintenance from date of Substantial Completion.

B. Weather Limitations: Proceed with planting only when existing and forecast weather conditions are suitable for work.

1.7 MAINTENANCE

A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days after date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. Replant bare areas with same materials specified for lawns.
2. Add new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).

1. Lay out temporary lawn-watering system and arrange watering schedule to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly seeded, plugged, or sprigged areas.
2. Water lawn at the minimum rate of 1 inch (25 mm) per week.

D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain following grass height:

1. Mow grass from 2 to 3 inches (50 to 75 mm) high.

E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.

1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on Schedules at the end of this Section.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
2. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.

2.3 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

D. Perlite: Horticultural perlite, soil amendment grade.

1. When site treated, mix with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.

G. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

H. Herbicides: EPA registered and approved, of type recommended by manufacturer.

I. Water: Potable.

2.4 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium.

B. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium.

2.5 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable dyed-wood cellulose-fiber mulch, nontoxic, free of plant growth- or germination-inhibitors, with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

2.6 EROSION-CONTROL MATERIALS

A. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

B. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseed overspraying.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PLANTING SOIL PREPARATION

A. Limit subgrade preparation to areas that will be planted in the immediate future.

B. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter.

C. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days. Either mix soil before spreading or apply soil amendments on surface of spread topsoil and mix thoroughly into top 4 inches (100 mm) of topsoil before planting.

1. A "Planting Soil Amendments Schedule" is included at the end of this Section.
2. Mix lime with dry soil prior to mixing fertilizer.
3. Apply superphosphate fertilizer directly to subgrade before tilling, at the rate indicated.

D. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.

1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
2. Allow for sod thickness in areas to be sodded.

E. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:

1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
2. Till surface soil to a depth of at least 6 inches (150 mm). Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches (100 mm) of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
3. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.

F. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches (38 mm) in any dimension, and other objects that may interfere with planting or maintenance operations.

G. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

H. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.4 SEEDING NEW LAWNS

A. Sow seed with a spreader or a seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

B. Sow seed at the following rates:

1. Seeding Rate: 3 to 4 lb per 1000 sq. ft. (1.5 to 2 kg per 100 sq. m).

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded slopes exceeding 1:4 against erosion with erosion-control blankets installed and stapled according to manufacturer's recommendations.

E. Protect seeded slopes exceeding 1:6 against erosion with jute or coir-fiber erosion-control mesh installed and stapled according to manufacturer's recommendations.

F. Protect seeded areas with slopes less than 1:6 against erosion by spreading straw mulch after completion of seeding operations. Spread uniformly at a minimum rate of 2 tons per acre (45 kg per 100 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil by suitable mechanical equipment.

2. Anchor straw mulch by spraying with asphalt-emulsion tackifier at the rate of 10 to 13 gal. per 1000 sq. ft. (41 to 53 L per 100 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas against hot, dry weather or drying winds by applying peat mulch within 24 hours after completion of seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) thick and roll to a smooth surface.

3.5 HYDROSEEDING NEW LAWNS

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a 1-step process. Apply mulch at the minimum rate of 1500 lb per acre (16.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.6 SATISFACTORY LAWN

A. Seeded lawns will be satisfactory provided requirements, including maintenance, have been met and a healthy, uniform, close stand of grass is established, free of weeds, bare spots exceeding 5 by 5 inches (125 by 125 mm), and surface irregularities.

B. Replant lawns that do not meet requirements and continue maintenance until lawns are satisfactory.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto surface of roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period until lawn is established.

3.8 PLANTING SOIL AMENDMENTS SCHEDULE

A. Lawns: Provide soil amendments in not less than the following quantities:

1. Weight of lime per 1000 sq. ft. (100 sq. m): 90lbs
2. Weight of commercial fertilizer per 1000 sq. ft. (100 sq. m): 11lbs

3.9 SEED MIXTURES SCHEDULE

A. Full-Sun Mixture: Provide certified grass-seed blends or mixes, proportioned by weight, as follows:

Proportion	Name	Min. Pct. Germ.	Min. Pct. Pure Sd.	Max. Pct. Weed Sd.
100 pct.	Bermudagrass	80	85	0.50

(Cynodon dactylon)

B. Sun and Partial Shade: Provide certified grass-seed blends or mixes, proportioned by weight, as follows:

Proportion	Name	Min. Pct. Germ.	Min. Pct. Pure Sd.	Max. Pct. Weed Sd.
50 pct.	Kentucky bluegrass (Poa pratensis)	80	85	0.50
30 pct.	Chewings red fescue (Festuca rubra variety)	85	98	0.50
10 pct.	Perennial rye grass (Lolium perenne)	90	98	0.50
10 pct.	Redtop (Agrostis alba)	85	92	1.00

C. Heavy Shade: Provide certified grass-seed blends or mixes, proportioned by weight, as follows:

Proportion	Name	Min. Pct. Germ.	Min. Pct. Pure Sd.	Max. Pct. Weed Sd.
50 pct.	Chewings red fescue (Festuca rubra variety)	85	98	0.50
35 pct.	Rough bluegrass (Poa trivialis)	80	85	1.00
15 pct.	Redtop (Agrostis alba)	85	92	1.00

END OF SECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Excavating tree pits and planting beds.
   2. Preparation of subsoil and topsoil.
   3. Topsoil bedding.
   4. Mulch.
   5. Fertilizer.
   6. Pruning.
   7. Maintenance.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 02200 – Earthwork: Excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.
   2. Section 02930 - Lawns and Grasses: Topsoil, finish grading and seeding.

1.3 REFERENCES

A. American National Standards Institute:
   1. ANSI A300 – Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices.
   2. ANSI Z60.1 – Nursery Stock.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Section.

B. Product data and samples (as note) for the following:
   1. Fertilizers and lime.
   2. Soil amendments (sample).
   3. Topsoil (sample).
   4. Mulches(sample).
   5. List of plant material sources.

C. Product certification, including:
   1. NJ Dept. of Agriculture Certificate of Plant Inspection.
   2. NJ Dept. of Agriculture Dealer’s Agreement.

D. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects, landscape architects and owners, and other information specified.

E. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the materials with requirements indicated.
   1. Analysis of existing topsoil (stock piled and undisturbed).
   2. Analysis of imported topsoil.
   3. Analysis of organic compost.

F. Planting schedule indicating anticipated dates and locations for each type of planting.

G. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications. Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful plant establishment.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Topsoil analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
   1. Report suitability of topsoil for plant growth. State recommended type and quantities of soil amendments to be added to produce a satisfactory topsoil.

D. Organic Compost analysis: Furnish a compost analysis made by a qualified independent testing laboratory stating organic matter content, pH, percent of moisture content, conductivity, and existing levels of basic nutrients
   1. Report raw materials used to make compost.

E. Perform Work in accordance with State, County, and City laws and standards.

F. Maintain one copy of Project plans and specifications on site.

G. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings".

1.6 DELIVERY, STORAGE, AND HANDLING

A Deliver products in original sealed, labeled, and undamaged containers.

B. Deliver plants labeled according to genus, specie, and variety and supplier bill of lading.

C. Transport plants with protective covering and trunk protection.

D. Store plants with root balls set on moist straw and covered with same. Protect tops and trunks from drying by sun and wind. Water daily.

1.7 COORDINATION AND SCHEDULING

A. General: Coordinate all work according to the Conditions of the Contract and Division 1 Specification Sections.

B. Coordinate installation of plant life with installation of underground utilities and grading and seeding.

C. Planting Season: Install plants during normal planting season for plant type and method of transplanting. Correlate planting with specified maintenance periods to provide required maintenance from date of Substantial Completion.

D. Weather Limitations: Proceed with planting only when existing and forecast weather conditions are suitable for work.

1.8 WARRANTY

A. Furnish one year warranty for trees, shrubs, and ground cover, begin at Date of Substantial Completion, including:
   1. Replacement upon death or exhibiting poor health, including: disease, loss of foliage, die-back of twigs and branches greater than 10 percent initial plant size, and splitting bark.
   2. Replacement without cost to the Owner, except in cases of violent weather, vandalism or abuse.

1.9 MAINTENANCE SERVICE

A. Maintain plant life for twelve months after Date of Substantial Completion.

B. Maintain plant life immediately after placement until plants are well established and exhibit vigorous growing condition. Continue maintenance until termination of warranty period.

C. Maintenance includes:
   1. Cultivation and weeding plant beds and tree pits.
   2. Applying herbicides and insecticides. Remedy damage resulting from use.
   3. Irrigating sufficient to sustain vigorous, healthy growth.
   4. Pruning, including removal of dead or broken branches.
   5. Fertilizing to sustain vigorous, healthy growth.
   6. Resetting plants to proper grade and vertical position.
   7. Plant replacement.
   8. Replacement of mulch.

PART 2 – PRODUCTS

2.1 TREES, SHRUBS, AND GROUND COVER

A. Plant Stock:
   1. Species: In accordance with Standardized Plant Names, official code of American Joint Committee on Horticulture Nomenclature.
   2. Identification: Label each plant or group of the same plant type.
   3. Plants: No. 1 Grade conforming to “American Standard for Nursery Stock” of American Nursery & Landscape Association (formerly AAN); well-branched, vigorous and balanced root and top growth; free from disease, injurious insects, mechanical wounds, broken branches, decay and other defects.
   4. Trees: Furnish with reasonably straight trunks, well balanced tops, single leader, and trunks centered in root ball.
   5. Method of transplanting: Balled and burlapped or container as specified in plant schedule.

B. Trees, shrubs, and ground cover: Genus, species, and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.2 SOIL MATERIALS

A. Topsoil: Sandy loam topsoil, pH range of 6.0 to 7.0 with 4 percent organic material minimum; free of stones 1 inch (25 mm) or larger in any dimension, subsoil, clay, plants, weeds, roots, impurities, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled and spread on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
2. Topsoil Source: Import topsoil from off-site sources. Manufactured or fertile agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from well drained site.

2.3 SOIL AMENDMENT MATERIALS

A. Compost: Commercially manufactured, stable organic compost derived primarily from composted yard trimmings; pH range of 6.0 to 8.0, and organic matter content 30 to 50 percent.

B. Peat-bark Mix: Medium-weight, peat-bark growing medium, components: processed pine bark (45-55% by volume), sphagnum peat moss (37-47% by volume), horticultural coarse grade perlite, calcitic limestone, dolomitic limestone, macro & micro nutrients, and wetting agent; pH range 5.2 - 6.2.

C. Lime: Dolomitic limestone, 50% total oxides, 30% calcium oxide, 20% magnesium oxide, with minimum 75% passing a 100 mesh sieve and a minimum passing a 20 mesh sieve.

D. Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent (min.) derived from natural organic sources in the following composition:
   1. Composition: 5 percent nitrogen, 3 percent phosphorus, and 3 percent potassium by weight.

2.4 MULCH MATERIALS

A. Mulching Material: Double shredded hardwood bark, dark brown in color, free of soil and extraneous matter.

B. Mulching material: Wheat straw, free from weeds, foreign matter detrimental to plant life, and dry.

2.5 ACCESSORIES

A. Drip Irrigation Bladder: 10 mil., UV polyester reinforced polyethylene, 20 gal. capacity.

B. Monitoring Tubes: PVC, perforated field drain pipe w/ filter fabric cover; 4” dia. x 36” length; threaded adaptor & thread end cap.

2.6 PLANT SOIL MIX

A. Plant Soil Mix: Uniform mixture of 2 parts peat-bark mix and 3 parts sandy loam topsoil by volume.

2.7 HERBICIDE

A. Herbicide for weed control, including:
   1. Non-Selective Herbicide: Water soluble, spray application, for total weed control.
   2. Selective Pre-Emergent Herbicide: Granular, dry application, for pre-emergent control of broadleaf weeds and grasses.

2.8 GRASS SEED

A. Lawn grass and Low-maintenance grass seed mixes and varieties according to Division 2 Section “Lawns and Grasses”.

2.9 WATER

A. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of plants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Locate all underground utilities before digging.

3.2 EXCAVATION

A. Remove soil from planting pits to width and depth shown on the Planting Details.

B. Retain satisfactory soil for reuse. Remove unsatisfactory soil, foreign materials and debris. Properly dispose off site.
C. Scarify subsoil to depth of 4 inches (100 mm) the entire surface at bottom of planting pit.

D. Dig pits and beds 6 feet wide or twice the width of the root ball, whichever is greater, or as shown on the planting details.

3.3 PLANTING

A. Add plant soil mix to bottom of planting pit to the depth shown on the Planting Details; evenly blend with Subsoil. Tamp firm and stable under each root ball.

B. Place plants for best appearance. Review and final orientation by the Landscape Architect.

C. Set plants vertical.

D. Set top, outer edge of root ball flush with finish grade.

E. Remove containers. Cut and remove (or fold away) burlap and binding from top of root ball. Cut top bands of wire baskets and fold away from top of root ball.

F. Container Grown Plants: Use fingers or small hand tools to pull roots out of outer layer of potting soil; cut or pull apart any roots circling the perimeter of the container.

G. Prune broken and frayed roots.

H. Trees: Install monitoring tubes:
1. Place in corner of tree planting pit. End cap flush with finish grade.
2. Gently slope bottom of pit toward monitoring tube.
3. Maintain vertical position during backfilling and tamping.
4. Keep tube free of soil and debris during and after installation.

I. Backfill planting soil mix in 6 inch (150 mm) layers. Tamp each layer firmly around root ball. Maintain each plant in vertical position. Fill to slightly below finish grade elevation.

J. Saturate soil with water when planting pit is half full of soil mix and again when full.

K. Apply 3 inches (75 mm) to 4 inches (100 mm) of organic compost to surface of filled planting area. Till and blend evenly into top 6 inches (150 mm).

L. Drip Irrigation Bladder: Install at each tree, including:
   1. Shade trees.
   2. Small single- and multi-trunk ornamental trees.

3.4 HERBICIDE

A. Selective Pre-emergent Herbicide:
   1. Apply to planting bed and tree pit surfaces prior to mulching.
   2. Remove weeds before applying.
   3. Application required for spring and summer planting.
   4. Apply according to manufacturer recommendations.

3.5 MULCHING

A. Mulch planting surfaces with 3 inch (75 mm) depth, hardwood bark mulch. Apply within 24 hours of planting.

3.6 PRUNING

A. When pruning trees is required, lightly prune trees in accordance with ANSI A300 Maintenance Pruning Type: Crown Pruning. Prune to preserve tree natural shape.

3.7 SEEDING

A. Reseed grass areas disturbed by planting work.

B. Loosen compacted soil, add topsoil (as necessary), rake, grade smooth and even to proper finish grade.

C. Seed mixes and varieties, application rates, and method of application and mulching according to Division 2 Section “Lawns and Grasses”.

3.8 FIELD QUALITY CONTROL

A. Plants will be rejected when:
   1. Size, genus, species, variety, and/or quality do not meet or exceed requirements specified herein.
   2. Improperly or not labeled.
   3. Not properly covered and protected during transport and delivery.
   4. Failure to provide current NJ Dept. of Agriculture Certificate Inspection.
   5. Tree trunks improperly protected.
   6. Tree trunks damaged, bent, curved, or configuration not typical of species.
   7. Root ball disturbed or damaged prior to or during planting.

END OF SECTION

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. Slabs-on-grade.
2. Concrete toppings.

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 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. The contractor shall deliver to the engineer, at the completion of the job, one (1) electronic version of the final field copies of all steel reinforcing shop drawings.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

F. Samples: For waterstops and vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.
15. Mechanical Splices.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control test and inspection reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on-project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures through single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code-Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, “Specification for Structural Concrete.”
2. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials.”
3. ACI 216, “Guide for Determining Fire Endurance of Concrete Elements”.

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Cast concrete slab-on-grade and formed-surface panels as required by the Architect/owner to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials. Utilize steel, glass-fiber-reinforced plastic, or other approved non-absorptive panel material that will provide continuous, true and smooth surfaces in all architectural concrete.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

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. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. 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.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 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. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) ASTM A 706/A 706M, deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82 /A 82M.

E. Deformed-Steel Wire: ASTM A 496/A 496M.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/ A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut 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.

C. Mechanical Splices: For splicing reinforcing bars, splice material must conform with testing set forth in ASTM 1034/1034M, and shall develop in tension or compression, as required, at least 125% of the specified yield strength of the bar.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, color as indicated on Architectural Contract documents. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class **3S** coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M and potable.

2.5 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.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
    b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
    c. Euclid Chemical Company (The), an RPM company
    d. Grace Construction Products, W. R. Grace & Co.; DCI.
    e. Sika Corporation; Sika CNI.
    f. Or equal.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
    b. Cortec Corporation; MCI- 2000 2005NS.
    c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
    d. Sika Corporation; FerroGard 901.
    e. Or equal.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. ChemMasters.
    b. Davis Colors.
    c. Dayton Superior Corporation.
    d. Hoover Color Corporation.
    e. Lambert Corporation.
    f. QC Construction Products.
    g. Rockwood Pigments NA, Inc.
    h. Scofield, L. M. Company.
    i. Solomon Colors, Inc.
    j. Or equal.

2. Color: As selected by Architect.

2.6 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
    b. CETCO; Volclay Waterstop-RX.
    c. Concrete Sealants Inc.; Conseal CS-231.
    d. Greenstreak; Swellstop.
    e. Henry Company, Sealants Division; Hydro-Flex.
    f. JP Specialties, Inc.; Earth Shield Type 20.
    g. Or equal.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder under slab-on-grade: ASTM E 1745, Class A, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
    b. Fortifiber Building Systems Group; Moistop Ultra 10.
    c. Insulation Solutions, Inc.; Viper VaporCheck 10.
    d. Meadows, W. R., Inc.; Perminator 10 mil.
    e. Raven Industries Inc.; Vapor Block 10.
    f. Stego Industries, LLC; Stego Wrap 10 mil Class A.
    g. Or equal.

2.8 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Floor treatment applies to the exposed loading dock slab.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

    a. ChemMasters; Chemisil Plus.
    b. ChemTec Int'l; ChemTec One.
    c. Conspec by Dayton Superior; Intraseal.
    d. Curecrete Distribution Inc.; Ashford Formula.
    e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
    f. Edoco by Dayton Superior; Titan Hard.
    g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    h. Kaufman Products, Inc.; SureHard.
    i. L&M Construction Chemicals, Inc.; Seal Hard.
    j. Meadows, W. R., Inc.; LIQUI-HARD.
    k. Metalcrete Industries; Floorsaver.
    l. Nox-Crete Products Group; Duro-Nox.
    m. Symons by Dayton Superior; Buff Hard.
    n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.

o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
p. Or equal.

2.9 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Or equal.

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, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:

a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.

i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
l. Meadows, W. R., Inc.; Vocomp-20.
m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Or equal.

2.10 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. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.12 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: Fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume may be used to reduce the total amount of portland cement. 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: 40 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 water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use 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.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on contract documents.
2. Minimum Cementitious Materials Content: 500 lb/cu. yd. (297 kg/cu. m).
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size for slabs exposed to freeze and thaw only.
5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

B. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on contract documents.
2. Minimum Cementitious Materials Content: 500 lb/cu. yd. (297 kg/cu. m).
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size for slabs exposed to freeze and thaw only.
5. Air Content: Do not allow air content of troweled finished toppings to exceed 3 percent.

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C116M, 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 per Architectural documents and designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) 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. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

Retain option in first subparagraph below if adopting recommendation of ACI 347. ACI 301 requires concrete to reach its specified compressive strength.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 347 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet 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.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: 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.

3.8 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. 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.

E. 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.

F. 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.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view as indicated on Architectural documents.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete as indicated on Architectural documents.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent

surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes and as indicated on Architectural documents.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated and to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo and as indicated on Architectural documents.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and 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 and as indicated on Architectural documents.
2. Finish on-grade and supported surfaces to the applicable minimum following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface. The contractor shall supply floor leveling material and other corrective measures in areas where floor finish provisions exceed the flatness and levelness requirements. Per ACI 302.1R, F(L) requirements should only be applied to slabs-on-ground that are level and suspended slabs that are both level and shored.

    a. For carpeted slabs, specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
    b. For thin floor coverings, 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.

c. For thin floor coverings, specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method and as indicated on Architectural documents. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, 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.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread dampened slip-resistive aggregate or aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.

3.12 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.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a 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. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. 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.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six 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.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete, Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Except as otherwise indicated on drawings or specified herein, all work under this Section shall conform to applicable requirements of the local Building Code and regulations of all government authorities having jurisdiction, applicable State Code, and ACI 318.

B. Testing and Inspecting: Engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and to prepare and submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.

6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. 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, and either ASTM C617 (Bonded Caps) or ASTM C1231 (Unbonded Caps).

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
    c. Cast and field cure additional sets of two standard cylinder specimens for construction sequencing purposes 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.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033600 - MECHANICALLY GROUND AND POLISHED CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

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

B. Section Includes:
   1. Polished concrete interior floor slabs.
   2. Curing of polished concrete.
   3. Densified & Mechanically Polished concrete.

C. Related Sections:
   1. Division 3 Section “Cast-In-Place Concrete” for general applications of concrete and coordination of sample submittal [and color selection].
   2. Division 7 Section “Joint Sealants” for sealant for joints.

1.2 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301 “Specification for Structural Concrete for Buildings.”
   2. ACI 302 IR “Recommended Practice for Concrete Floor and Slab Construction.”
   3. ACI 303.1 “Standard Specification for Cast-In-Place Architectural Concrete.”
   4. ACI 304 “Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete.”
   5. ACI 305R “Recommended Practice for Hot Weather Concreting.”
   6. ACI 306R “Recommended Practice for Cold Weather Concreting.”

B. American Society for Testing and Materials (ASTM):
   1. ASTM C309 “Liquid Membrane-Forming Compounds for Curing Concrete.”
   2. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”
   3. ASTM C979 “Standard Specification for Pigments for Integrally Colored Concrete.

C. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO M194 “Chemical Admixtures.”

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s complete technical data sheets for the following:
   1. Wet Curing Blanket.
   2. Liquid Lithium Silicate Densifiers
   3. Protective Blanket for Polished Concrete Floors

B. Design Mixes: For each type of polished concrete.

C. Qualification Data: For firms indicated in “Quality Assurance” Article, including list of completed projects.

D. Submit the following in accordance with Division 1.

E. Product data for each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator and any other chemicals used in the process.

F. Applicators qualification data.

G. Polished concrete samples: For each Polished Concrete finish required.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with 10-years experience in the production of specified products.
B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality.

C. Comply with the requirements of ACI 301.

D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.

E. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.

F. Pre-installation Conference: Conduct conference at project site to comply with requirements in Division 1.

G. Provide project names, addresses, contact names, phone numbers of at least three (3) projects of similar scope completed by the installer.

H. Installer/Applicator shall be certified by concrete finish equipment and chemical manufacturer and shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.

I. Manufacturer’s Certification: Provide a letter of certification from both the equipment and chemical manufacturer stating that the installer is a certified applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.

J. Polished Concrete Mockups.
   1. Provide under provisions of Division 1.
   2. At location on Project selected by Architect place and finish 10 ft. by 10 ft. area.
   3. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
   4. Retain samples of cements, sands and aggregates used in mockup for comparison with materials used in remaining work.
   5. Aggregate selected must be tested to ensure it will accept polish.
   6. Edges should be included in mockup.
   7. Accepted mockup provides visual standard for work of Section.
   8. Mockup shall remain through completion of work for use as a quality standard for finished work.
   9. Remove mockup when directed.

K. Environmental Limitations:
1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
2. Application of finish system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
3. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions. Deliver colored admixtures and liquid densifiers in original, unopened packaging. Store in dry conditions.

1.6 PROJECT CONDITIONS

A. Polished Concrete Environmental Requirements:
1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
2. Avoid placing concrete if rain, snow, or frost is forecast within 24-hours. Protect fresh concrete from moisture and freezing.
3. Comply with professional practices described in ACI 305R and ACI 306R.

B. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturer's written recommendations.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. L.M. SCOFIELD COMPANY or equal.

2.2 MATERIALS & EQUIPMENT

A. Wet Curing Blanket for Polished Concrete: Wet Curing Blanket shall comply with ASTM C309 and be acceptable for use with polished concrete.
1. MC Tech Group – Ultracure NCF Wet Curing Blanket, 866-913-8363
2. Wet Cure Polished Concrete slab 7 days.

B. Chemical Hardener/Densifiers Manufactured by L.M. SCOFIELD COMPANY:

a. SCOFIELD® Formula One Lithium Densifier MP™ is a high performing liquid hardening and dust proofing compound that is chemically reactive and permanently bonds to concrete formulated to be used in conjunction with polished concrete.
b. SCOFIELD® Formula One Guard-W Finish Coat

C. 3 head or 4 head counter rotating variable speed floor grinding machine with at least 600 pounds down pressure.

D. Dust extraction system, pre-separator, and squeegee attachments with minimum flow rating of 322 cubit feet per minute.

E. Protective Blanket System: Dura Cover by Proguard: 877-977-6482

F. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:
   1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.
   2. Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that Architect can examine.

2.3 COLORS

A. Concrete Color:
   1. Cement: Color shall be gray.
   2. Sand: Color shall be locally available natural sand.
   3. Aggregate: Concrete producer's standard aggregate complying with specifications.

2.4 CONCRETE MIX DESIGN

A. Minimum Cement Content: 5 sacks per cubic yard of concrete.

B. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches. If super plasticizers or mid-range water reducers are allowed, slump shall not exceed 8-inches.

C. Do not add calcium chloride to mix as it causes mottling and surface discoloration.

D. Supplemental admixtures shall not be used unless approved by manufacturer.

E. Do not add water to the mix in the field.

PART 3 – EXECUTION

3.1 CONCRETE INSTALLATION

A. Install concrete according to requirements of Division 3 Section “Cast-In-Place Concrete.”

B. Do not add water to concrete mix in the field.

C. Surfaces shall be finished uniformly with the following finish:
   1. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.
   2. Finish concrete shall have a minimum Floor Levelness rating of at least 30.
   3. Finish concrete shall be cured a minimum of 28 days or at which point equipment can be put on the slab and does not displace aggregate.
   4. Ground and Polished Concrete Surface: Precautions should be taken to insure the surface is in tolerances to perform this function.

3.2 CURING

A. Polished Concrete: Install wet curing blanket in accordance with manufacturer's recommendations. Wet cure for 7 days. Cured Concrete floor shall be wet cleaned with an Auto Scrubber as the wet blankets are removed to remove any surface laitance.

B. Do not cover concrete with plastic sheeting.

C. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 *Plastic Shrinkage Cracking* published by the National Ready Mixed Concrete Association.

3.3 MECHANICALLY POLISHED CONCRETE CUT AND SHINE LEVELS

A. Cut Level (Depth of cut)
   1. Polish only

B. Shine Level
   1. Class 1 – 400 grit polish

C. Polished concrete finish coat
   1. At a distance of 100 feet, the floor will reflect images from side lighting.
   2. Apply two applications of SCOFIELD® Formula One Guard-W.

3.4 MECHANICALLY POLISHED CONCRETE APPLICATION

A. Applicator shall examine the areas and conditions under which work of this section will be provided and the General Contractor shall correct conditions detrimental to the timely and proper completion of the work and the Applicator shall not proceed until unsatisfactory conditions are resolved.

B. Grind the concrete floor to within 2 – 3 inches of walls with 150 grit removing construction debris, floor slab imperfections and until there is a uniform scratch pattern and desired concrete aggregate exposure - grinding 90 degrees from each previous grind and removing all the scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.

C. Grind the edges up to 150 grit grinding pads removing all the scratches from the previous grit. Vacuum the floor thoroughly after each grind using a squeegee vacuum attachment.

D. Fill construction joints and cracks with filler products as specified in accordance with manufacturer's instructions colored to match with concrete color.

E. Apply densifying impregnator undiluted at approximately 200-400 square feet per gallon using a stiff, long bristled broom. Cover the entire area liberally. Using a broom, work the densifier into the substrate for 30 minutes. During this 30-minute period, continually keep the substrate wet with densifier. Squeegee excess material off the floor. Remove all residue by scrubbing and flushing surface with clean water Allow 12 to 24 hours for full cure.

F. Polish the floor, to desired sheen level, with phenolic resin bonded diamond grits. Remove all scratches from the previous grit. After each polish, clean the floor thoroughly using clean water and an auto scrubber or a mop and a wet vacuum.

G. Using a high speed (2400 rpm) burnishing machine equipped with 800 grit diamond impregnated pads, buff the surface to the specified shine level.

H. Spray apply Guard-W Finish Coat at a rate of 400 square feet per gallon. Allow to dry for 1-2 hours.

I. Using a low speed (1500 rpm) burnishing machine equipped with “white” pad, buff the surface to the specified shine level.

J. Upon completion, the work shall be ready for final inspection and acceptance by the customer.

3.5 TOLERANCES

A. Minor variations in appearance of polished concrete, which are similar to natural variations in color and appearance of unpolished concrete, are acceptable.

3.6 CLEANING

A. The work area shall be kept clean and free of debris at all times.

B. Remove slurry and dust from adjoining surfaces as necessary.

C. Dispose of material containers in accordance with local regulations.

D. Protect finished work until fully cured per manufacturer’s recommendations.

3.7 PROTECTION

A. Protect concrete floors prior to as well as after the polishing process with ProGuard Dura Cover Protective Blankets (877-977-6482)

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the insulated precast concrete foundation wall system.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: The wall system shall be designed to accommodate all design loads imposed by the structure depicted in the project documents and shall transmit those loads to the supporting soils.

B. Panels have been evaluated and are capable of carrying axial compressive load of 5,500 lb/lf.

C. Support ledges have been evaluated and are capable of carrying a load of 2,900 lb/lf.

D. Wall system has been evaluated as an alternative method of providing foundation wall dampproofing therefore no additional dampproofing is required.

E. Wall system's interior finish has been evaluated to ANSI / UL 1715 and an independent thermal barrier is not required.

F. Wall system has been evaluated to withstand a backfill force of 100 lb/ft^3.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's pertinent product literature including International Code Council Evaluation Service Report.

B. Shop Drawings: Provide Shop Drawings for approval prior to fabrication. Shop drawings shall indicate dimensions, window and door placements, beam pocket locations, brick ledge and support ledge requirements and all other special dimensioning requirements. Drawings shall also include the following:

a. Design Loading
b. Footing Design & Material
c. Concentrated loads and their points of application
d. Soil Bearing Capacity
e. Maximum allowable total uniform load
f. Seismic Design Category
g. Basic Wind Speed

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Manufacturing plant shall be a certified by the products licensor.

B. Quality Control Standard: Comply with written quality control procedures in accordance with ICC-ES Acceptance Criteria AC10.

C. Third Party Inspection: Independent third party inspections of the manufacturing facility shall be provided by an approved inspection agency. Wall sections shall bear a certificate of inspection label issued by the approved agency.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver wall panels on trucks with specially designed racks to prevent cracking and damage.

B. Wall panels shall be stored in a manner to minimize potential damage.

C. Lift and place wall sections utilizing cast-in lift pins and appropriate spreader bar.

1.6 WARRANTY

A. Manufacturer shall warrant its foundation for 15 years from the date of installation to be free of defects in workmanship and materials, as well as sidewall groundwater penetration.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Products shall be manufactured by Northeast Precast LLC.

2.2 WALL SYSTEM

A. The wall system shall be an insulated, steel-reinforced, precast concrete wall system.

B. Panel Height: as noted on shop drawings.

C. Overall Wall Panel Thickness: 10 ¼" Superior Wall

D. Overall Wall Panel Thickness: 12" solid wall

E. Insulation: Integral 2½" thickness of DOW STYROFOAM insulation providing an R-12.5 insulating value. Foam shall be labeled in accordance with ICC-ES ESR and shall not require installation of a thermal barrier on the interior of the wall panels.

F. Concrete Mix: 5000psi minimum compressive strength at 28 days; reinforced with polypropylene fiber; maximum water/cementitious materials ratio of 0.40 and minimum air entrainment of 4%.

G. Concrete Studs: 24" o. c. maximum spacing, insulated with 1" of EPS foam, and faced with 24 gauge galvanized stud facings for future interior finishing.

H. Wiring Allowance: Concrete studs and panel ends shall have pre-formed 1" diameter holes to allow for electrical wiring installation.

I. Steel Reinforcement: Concrete studs reinforced with one (1) #4, Grade 60 deformed rebar.

Each upper bond beam and footer beam shall be reinforced with two (2) continuous #3, Grade 40 deformed rebars.

J. Sealants: All sealants used on the wall system shall be one part polyurethane approved by licensor.

2.3 EXTERIOR FINISH

A. Broom finish exterior wall surface during manufacture.

B. Optional brick/stone support ledge and wall ties.

PART 3 – EXECUTION

3.1 SITE PREPARATION

A. The jobsite shall be prepared according to manufacturer's detailed instructions per their latest edition. Unless otherwise noted in the project documents, the building contractor is responsible to prepare the jobsite.

3.2 INSTALLATION

A. Installation shall be conducted by an installation crew that is certified by the licensor.

B. Installation Crews shall comply with published Installation Manual latest edition.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Rough carpentry and finish carpentry. Refer to Schedule located at the end of this Section.

B. Wall and roof sheathing.

C. Preservative treatment of wood.

D. Concealed wood blocking for support for accessories, etc.

E. Miscellaneous items and accessories.

F. Painted wood base and sills.

1.2 RELATED WORK

A. Division 06 – Shop-Fabricated Wood Trusses

B. Division 07 - Sheet Metal Flashing and Trim.

C. Division 09 - Gypsum Board.

D. Division 09 - Painting.

1.3 REFERENCES

A. ALSC American Lumber Standards Committee: Softwood Lumber Standards.

B. APA: American Plywood Association.

C. AWPA (American Wood Preservers Association) C1 All Timber Products Preservative Treatment by Pressure Process.

D. NFPA: National Forest Products Association.

E. SPIB: Southern Pine Inspection Bureau.

F. WWPA: Western Wood Products Association.

G. NEMAL D3-1985: High pressure decorative laminates.

H. FSMMM-A-130- Adhesive, contact.

1.4 QUALITY ASSURANCE

A. Rough Carpentry Lumber: Visible grade stamp, of agency certified by National Forest Products Association (NFPA).

B. When applicable, fabricate cabinetry and site made finish carpentry items in accordance with recommendations of Quality Standards of Architectural Woodwork Institute (AWI).

C. Perform work in accordance with the following agencies:

D. Lumber Grading Agency: Certified by ALSC.

E. Plywood Grading Agency: Certified by APA.

1.5 SUBMITTALS

A. Submit standard colors and patterns of plastic laminate for Architect/Owner selection.

B. Submit shop drawings of aluminum louvers.

C. Submit shop drawings for custom cabinetry and custom countertops.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not deliver shop fabricated carpentry items until site conditions are adequate to receive the work. Protect items from weather while in transit.

B. Store indoors, in ventilated areas with a constant, minimum temperature of 60 degrees F, maximum relative humidity of 25 to 55 percent.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until the building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Coordinate construction to ensure that the actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

1.8 COORDINATION

A. Coordinate layout installation of blocking and reinforcement in partitions for support of cabinets.

PART 2 - PRODUCTS

2.1 ROUGH CARPENTRY MATERIALS

A. Lumber: PS 20; graded in accordance with established Grading rules; maximum moisture content of 15% - 19%; of the following species and grades.

1. Structural Light Framing: Stress Group B; Hem fir; No 1 grade.
2. Non-Structural Light Framing and Blocking: Stress Group C; standard grade.

3. Laminated Beams: Laminated parallel strand lumber. ‘Parallam’ as manufactured by Weyerhaeuser or approved equal, Fb = 2,900 psi, E = 2.0 x 106 psi.
4. Beams and Headers: Stress Group B; Hem Fir; No. 1 grade.
5. Studding: Stress Group B; Hem-Fir; No. 2 Grade.
6. Structural Joists: Stress Group B; Hem-Fir; No. 2 Grade.

B. Plywood Roof Sheathing: 5/8" thick APA Rated Sheathing, Span Rating 40/20; Exterior Exposure Durability - 1.

C. Plywood Wall Sheathing: 1/2" APA Rated Sheathing, Span Rating 24/16; Exterior Exposure Durability - 1.

D. Plywood Panel Backboards: 3/4" thick, APA Rated Sheathing, Structural I, Grade C-D; Exposure Durability 1; sanded.

E. Nails, Spikes and Staples: Galvanized for exterior locations. high humidity locations and treated wood; plain finish for other interior locations; size and type to suit application.

F. Anchor Bolts, Nuts, Washers, Lags, Pins and Screws: Medium carbon steel; sized to suit application; galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations.

G. Framing Connectors: Galvanized finish; size and profile to suit application.

H. Termite Shield and Miscellaneous Flashing: Sheet aluminum.

2.2 PAINTED WOOD BASE AND SILLS

A. Painted Wood Base:

1. Poplar, 1 x 4 with square edge; painted.

B. Painted Wood Sills:

1. Poplar, 1 x with eased edge, depths as required and as indicated on Drawings; painted.

2.3 WOOD TREATMENT

A. Wood Preservative Pressure Treatment: AWPA Treatment C1 using water borne preservative with 0.25 percent retainage.

B. Shop pressure treat and deliver to site ready for installation wood materials requiring pressure impregnated preservatives.

PART 3 - EXECUTION

3.1 FRAMING

A. Set structural members level and plumb, in correct position.

B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Construct load bearing framing members full length without splices.

D. Double members at openings over 100 square inches. Space short studs over and under opening to stud spacing.

E. Place full width continuous sill flashings under framed walls on foundations. Lap flashing joint 4 inches.

F. Space members at 16 inches on center unless noted otherwise.

G. Coordinate installation of prefabricated wood trusses.

H. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

I. Coordinate curb installation with installation of decking and support of deck openings.

J. Install firestopping in all interior and exterior stud walls at height of acoustical tile ceiling in accordance with manufacturer's instructions.

3.2 SHEATHING

A. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing.

B. Secure wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered.

3.3 FINISH CARPENTRY

A. Verify adequacy of backing and support framing.

B. Install work in accordance with AWI Custom Quality Standards.

C. Set and secure materials and components in place, plumb and level.

D. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

E. Install trim with nails and glue. Picture frame window openings.

F. Ensure that mechanical, electrical and building items affecting this section of work are properly placed, complete and have been inspected by the Architect prior to commencement of installation.

G. All fasteners exposed to view are to be concealed.

H. Permanently fix counter bases to floor using appropriate angles and anchorages.

I. Install and adjust cabinet hardware to correct operation.

J. Install hardware, fixtures and accessories supplied under other sections. Install items in accordance with manufacturer's instructions.

K.

3.4 PREPARATION OF SITE FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentation, sand work smooth.

3.5 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

3.6 SCHEDULES

A. Rough Carpentry:

1. Structural and Non-Structural Framing.
2. Built-up Structural Beams.
3. Parallam Beams.
4. Sill Flashing under Exterior Framed Walls.
5. Wall Base and Window Sills.
6. Miscellaneous Furring and Stripping for Walls.
7. Roof and Wall Sheathing.
8. Behind Wall Wood Blocking for Support of Accessories, Shelving, Counters and Cabinets.
9. Firestopping of Walls and Ceilings.
10. Bracing for prefabricated wood trusses

END OF SECTION

PART I GENERAL

1.01 WORK INCLUDED

A. Structural design, fabrication and installation of heavy timber beams, columns, & trusses.

B. Perform all work required to properly complete the heavy timber work as shown on the drawings and as specified herein. Include any and all modifications to the design that are structurally required under 1.03 C. 2. of this section.

C. Provide all labor, materials, staging, scaffolding, temporary bracing, crane, hoists, rigging, equipment, and services necessary to perform the Work of this Section. The work includes, but is not necessarily limited to the following:

1. Timber components of every description, including beams, girts, plates, braces, ties, pegs, webs.

2. Miscellaneous hardware for heavy timber construction, including but not limited to: Plate connectors and bolts.

PART 2 PRODUCTS

2.01 GENERAL

A. Trusses and all components for a complete installation to be supplied by:

Harmony Timberworks
645 Roby Greene Road
Boone, NC 28607
(828) 264-2314
www.harmonytimberworks.com

2.02 TRUSSES

A. Timber shall be sized according to engineering requirements. Minimum size shall be 6" x 6" in all directions.

B. Timber species shall be #1 & Better Douglas Fir, S4S, FOHC

C. Unless otherwise noted, all timber shall be per "Standard Grading Rules for Western Lumber" by the Northeastern Lumber Manufacturers Association. Records of grade marks and certificates indicating conformance with the Specifications shall be maintained by the Contractor.

2.03 PEGS

A. Peg material shall be straight grained, all heartwood, knot free, and reaction free from Birch or Oak.

2.04 MISCELLANEOUS HARDWARE

A. Furnish and install all necessary hardware and metal shapes required for assembly and erection of the trusses.

B. All steel shapes, plates, and tubes, unless otherwise specified, shall conform to ASTM A-36, as amended to date. Steel pipe shall conform to ASTM 53, Grade B.

PART 3 EXECUTION

3.01 INSTALLTION – GENERAL

A. Installation of trusses shall be in accordance with the details and notes on the Drawings, the approved Shop Drawings, code requirements, and the best trade practices.

3.02 JOINERY

A. Joinery shall be in the best of the early English and early American traditions, designed for strength, shrinkage, checking, and twisting. ****OPTIONAL**** **Metal** connections shall not be used unless required by the structural design, and, in those cases, must be concealed and held at an absolute minimum, meeting the Architect's approval. All workmanship shall be of the very highest quality.

B. Or steel as detailed on Structural Drawings.

C. All joinery shall be accurately cut so as to make a neat, snug fit.

3.03 ERECTION

A. Truss components and assemblies must be checked for dimensions and anchorage accuracy before erection.

B. Temporary bracing and guy lines shall be provided to adequately protect all persons and property and to ensure proper alignment.

C. Padding or non-marking slings shall be used, and corners shall be protected with blocking.

D. The assembled trusses shall be reasonably straight, plumb, level and square. Portions of the structure not adequately braced by design shall have temporary braces until the decking is applied.

E. All joints shall be reasonably tight.

F. All joints that require pegging shall have pegs driven until snug or flush. Pegs shall protrude 1" – 2" on both sides of truss except where they should be flush as directed above. Broken pegs shall be removed and replaced. Pegs with a mushroomed head shall be cut off below that portion

G. Tools used to drive or pull joints together shall not permanently mar the finished surfaces of the trusses.

END OF SECTION

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. Wood roof trusses.
2. Wood truss bracing.

B. Related Requirements:

1. Section 061600 – Sheathing.

1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

B. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

B. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

1.6 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction and is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.
2. Maximum Deflection Under Design Loads:

a. Roof Trusses: Vertical deflection of 1/360 of span.

C. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."

2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Certified Wood: For metal-plate-connected wood trusses and permanent bracing, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. 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. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S.
4. Provide dry lumber with 15 percent maximum moisture content at time of dressing.

C. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.

D. Minimum Specific Gravity for Top Chords: 0.50.

E. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section 061053 - Miscellaneous Rough Carpentry.

2.3 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work:

1. Alpine Engineered Products, Inc.; an ITW company.
2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
3. CompuTrus, Inc.
4. Eagle Metal Products.
5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
7. Robbins Engineering, Inc.
8. Truswal Systems Corporation; an ITW company.
9. Or approved equal.

B. Source Limitations: Obtain metal connector plates from single manufacturer.

C. General: Fabricate connector plates to comply with TPI 1.

D. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

1. Use for interior locations unless otherwise indicated.

E. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, 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.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers offering products that may be incorporated into the Work:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.
6. Or approved equal.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/2 inches wide by 0.062 inch thick. Tie fits over top of truss and fastens to both sides of truss, inside face of top plates, and both sides of stud below.

E. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.6 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.7 SOURCE QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.

1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.

B. Correct deficiencies in Work that special inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses 24 inches o.c.; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Division 06 Section 061053 - Miscellaneous Rough Carpentry.
2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

L. Replace wood trusses that are damaged or do not meet requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND 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 wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.

1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION

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. Plastic-laminate cabinets.
2. Cabinet hardware

B. Related Sections include the following:

1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

2. Division 06 Section “Solid Surfacing Fabrications” for solid surface countertops and window sills.

1.3 REFERENCES

A. AWI – Quality Standards

B. FS MMM-A-130 – Adhesive, Contact.

C. National Electric Manufacturer’s Association (NEMA) LD3 – High Pressure Decorative Laminates.

D. PS 1 – Construction and Industrial Plywood.

E. PS 20 – American Softwood Lumber Standard.

F. APA – American Plywood Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.

C. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Plastic laminates.
3. Solid-surfacing materials.

D. Samples for Verification:

1. Plastic laminates, 4 by 4 inches, for each type, color, pattern, and surface finish.
2. Solid-surfacing materials, 6 inches square.
3. Exposed cabinet hardware and accessories, one unit for each type.

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.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products to site under provisions of Division 1 – General Requirements.

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 and relative humidity at occupancy levels 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 work under provisions of Division 1 – General Requirements.

B. Coordinate the work with plumbing and electrical rough-in.

PART 2 - PRODUCTS

2.1 COUNTERTOPS, CASEWORK MATERIALS AND MISCELLANEOUS ACCESSORIES

A. Wood Particleboard: #45 per AWI standard, composed of wood chips, medium density, made with high waterproof resin binders of grade to suit application; sanded faces, located as follows:

Item	Thickness
Drawer and Door Face	3/4" Particle Board
Cabinet Sides and Supports	3/4" 7-Ply Solid Core Plywood
Shelving	3/4" 7-Ply Solid Core Plywood
Drawer Construction	1/2" Solid Core Plywood
Pipe Screens	3/4" Particle Board
Back Panels	1/4" Hard Board

B. Certified Wood: Interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.2 MANUFACTURERS

A. Plastic Laminate:

1. Formica Corporation
2. Wilsonart
3. Or approved equal.

2.3 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3-1985, GP 50 Grade, .050 inch thick, General Purpose quality; All doors, drawers, countertops, backsplashes, etc. Color, pattern, and surface texture as selected by Architect. Assume 4 possible color selections.

B. Plastic Laminate Backing Sheet: LD 3 BK-20; .020 inch thick Backing Sheet grade, smooth surface finish, undecorated plastic laminate (all concealed locations).

C. Cabinet Liner: CL 20 grade, .020 inch thick, all interior casework surfaces.

2.4 ACCESSORIES

A. Adhesive: FS MMM-A-130 contact adhesive, Type recommended by AWI and laminate manufacturer to suit application.

B. Fasteners: Size and type to suit application.

C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; finish in concealed locations and finish in exposed locations.

D. Concealed Joint Fasteners: Threaded steel.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Shelf Standards: Stanley #1805 aluminum mortise mounted; size as appropriate per application.

C. Shelf Clips: Stanley CD1806 steel, bright zinc plated.

D. Drawer Slides: Blum BS426A (full extension), size as required.

E. Hinges: Stanley #1501-2 (self-closing), quantity per door as recommended by manufacturer.

F. Pulls: Stanley 4484, US26D; 4" wire pull. Color to be selected by Architect.

G. Locks: Laboratory grade, cylinder cam locks, with 5-disc tumbler mechanism, and a dull chrome-plated face. Tumblers and keys are brass, while plug and cylinder are die cast zinc alloy. Locks are equipped with RemovaCoreTM keying control. With the use of a control key, the key core of the lock assembly can be removed, and a new key core inserted, changing the entire locking system.
   1. Keying Option - 1: All locks are keyed alike. Each lock is keyed the same as all other locks, and a single key can operate every lock.

2.6 WORK SURFACES AND SINKS

A. Comply with physical and chemical resistance requirements for materials for tops, sinks, and accessories as specified herein and in accordance with SEFA 3-2010 Laboratory Work Surfaces.

B. Provide tops with smooth, clean, exposed surfaces and edges, in uniform plane, free of defects.

C. Provide 4” high x 1” thick back splash and end splash where tops abut walls, or where shown on drawings.
   1. Top sizes: Furnish tops in longest practical lengths, in configuration indicated on the drawings.

2.7 FABRICATION, GENERAL

A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

B. Cap exposed plastic laminate finish edges with material of same finish and pattern.

C. Door and Drawer Fronts: 3/4 inch thick; overlay style.

D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

E. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

F. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

G. Provide cut-outs for plumbing fixtures, fixtures, and fittings. Verify locations of cut-outs from on-site dimensions. Seal contact surfaces of cut edges.

H. All plastic laminate countertops to have 1-1/2" edge unless noted.

I. Solid surface fabrications to be performed by a certified Corian fabricator/installer.

J. 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.

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. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

B. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
5. Work surfaces shall be installed with nominal 1” overhang on the front and end, unless otherwise indicated on the shop drawings.
6. Level and shim as necessary. Shims shall generally not exceed 1/8”.
7. Install work surfaces to achieve a uniform alignment of the front edge of the top.
8. Only factory-prepared field joints, located per the shop drawings, shall be permitted.
9. Secure work surfaces to the understructure with adhesive or mechanical fasteners per the manufacturer’s recommendations.
10. Provide flush joints not to exceed 1/8” between work surface sections.
11. Grout butt joints with material and method per the manufacturer’s recommendation.
12. Backsplashes and end returns shall be secured in place with joints sealed per manufacturer’s recommendation.

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. Adjust moving or operating parts to function smoothly and correctly.

C. Clean work under provisions of Division 1 – General Requirements.

D. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

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. Millwork counter tops with sinks and cove backsplashes.
   2. Window sills.

B. Related Sections
   1. Division 06 Section – Custom Casework.

1.3 REFERENCES

A. Definitions:
   1. Solid Surface: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

B. Reference Standards:
   1. ANSI/NPA A208.2-09 - Medium Density Fiberboard (MDF) For Interior Applications
   2. ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants
   3. ASTM D638-10 - Standard Test Method for Tensile Properties of Plastics
   4. ASTM D785-08 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
   5. ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
   6. ASTM D5420-10 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
   7. ASTM E84-14 - Standard Test Method for Surface Burning Characteristics of Building Materials
   8. ASTM E228-11 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer
   9. ASTM G21-13 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
   10. ASTM G22-76(96) - Standard Practice for Determining Resistance of Plastics to Bacteria
   11. ASTM G155-13 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials
   12. CSA B45.5-11/ IAPMO Z124-2011 - Plastic Plumbing Fixtures
   13. NFPA 255-06 - Standard Method of Test of Surface Burning Characteristics of Building Materials
   14. NSF/ANSI 51-07 - Food Equipment Materials
   15. SCAQMD Rule 1168 - Adhesive and Sealant Applications (amended January 2005)
   16. UL 723 - Standard for Test for Surface Burning Characteristics of

Building Materials
17. UL Environment/ - Standard for Chemical Emissions for Building Materials, GREENGUARD - Finishes and Furnishings, Section 7.1
UL 2818
18. UL Environment/ - Gold Standard for Chemical Emissions for Building Materials, GREENGUARD - Finishes and Furnishings, Section 7.1 and 7.2
UL 2818
19. UL 2824 - GREENGUARD Certification Program, Method for Measuring
20. Microbial Resistance from Various Sources Using Static
21. Environmental Chambers

1.4 SUBMITTALS

A. Product Data: Indicate Product description including solid surface sheets, sinks, bowls and illustrating full range of standard colors, fabrication information and compliance with specified performance requirements. Submit Product data with resistance to list of chemicals.

B. Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. Indicate plans, sections, dimensions, component sizes, edge details, thermosetting requirements, fabrication details, attachment provisions, sizes of furring, blocking, including concealed blocking and coordination requirements with adjacent work. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacles and other items installed in solid surface.

C. Coordination Drawings: Submit coordination drawings indicating plumbing and miscellaneous steel work indicating locations of wall rated or non-rated, blocking requirements, locations and recessed wall items and similar items.

D. Samples: Submit samples in accordance with Section 01 30 00. Submit minimum 6" x 6" samples. Cut sample and seam together for representation of inconspicuous seam. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work.

1.5 CLOSEOUT SUBMITTALS

A. Operational and Maintenance Data:

1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.
2. Provide a commercial care and maintenance kit and video. Review maintenance procedures and warranty details with Owner upon completion.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Installers: Provide work of this Section executed by competent installers with minimum 5 years experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.

B. Storage and Handling Requirements:
   1. Store components indoors prior to installation.
   2. Handle materials to prevent damage to finished surfaces.

1.8 WARRANTY

A. Manufacturer Warranty: Provide manufacturer's standard warranty for material only for period of 10 years against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Architect and at no expense to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
   1. Corian® by DuPont
   2. Samsung Chemical USA
   3. Wilsonart Contract
   4. Or approved equal.

B. Substitution Limitations: This Specification is based on Corian® Products. Comparable Products from manufacturers listed herein will be accepted provided they meet requirements of this Specification.

2.2 MATERIALS

A. Performance Design Criteria:

Tensile Strength	6000 psi min	ASTM D638
Tensile Modulus	1.5×10^6 psi min	ASTM D638
Tensile Elongation	0.4% min.	ASTM D638
Flexural Strength	10000 psi min	ASTM D790
Flexural Modulus	1.2×10^6 psi min	ASTM D790
Hardness	>85-Rockwell "M" scale min.	ASTM D785
Thermal Expansion	2.2×10^{-5} in./in./°F	ASTM E228

Fungi and Bacteria	Does not support microbial growth		ASTM G21 & G22
Microbial Resistance	Highly resistant to mold growth		UL 2824
Ball Impact	No fracture - 1/2 lb. Ball: 6 mm slab - 36" drop 12 mm slab - 144" drop		NEMA LD 3, Method 3.8
Weatherability	∆E*94<5 in 1,000 hrs		ASTM G155
Flammability			ASTM E84, NFPA 255 & UL 723
	6mm	12mm	All Colors
Flame Spread	<25	<25	
Smoke Developed	<25	<25	
Class	A	A	NFPA 101®, Life Safety Code

B. Solid Surface Material: ½" thick. Color to be selected by Architect.

C. Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:

D. Flammability: Class 1 and A when tested to UL 723.

E. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.

F. Sealant: A standard mildew-resistant, FDA/UL® recognized silicone color matched sealant or clear silicone sealants.

G. Sink/Bowl Mounting Hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount sinks/bowls.

2.3 COMPONENTS

A. Counter Perimeter Frame: Ensure 1/2" thick, moisture resistant cores for counter tops in wet areas having sinks or lavatories are 3/4" thick exterior grade plywood with waterproof adhesive, Fir or Poplar plywood, veneer core only.

B. Fabrication:
1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and solid polymer manufacturer requirements. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings and bath accessories as indicated on Drawings.

2. Where indicated, thermoform corners and edges or other objects to shapes and sizes indicated on Drawings, prior to seaming and joining. Cut components larger than finished dimensions and sand edges to remove nicks and scratches. Heat entire component uniformly prior to forming.
3. Ensure no blistering, whitening and cracking of components during forming.
4. Fabricate backsplashes from solid surfacing material with optional radius cove where counter and backsplashes meet as indicated on Drawings. Backsplashes for most colors may be fabricated by traditional means discussed in K-25294 Backsplashes. Colors with metallic/mica particle or veined colors creating directional aesthetics (K-26833 Directional Aesthetics) may require the techniques in Technical Bulletin K-28235 Thermoformed Backsplash.
5. Fabricate joints between components using manufacturer's standard joint adhesive. Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid polymer material is not required when using DuPont™ Joint Adhesive 2.0.
6. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
7. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand edges smooth. Repair or reject defective or inaccurate work.
8. Finish: Ensure surfaces have uniform finish:
   a. Matte, with a 60° gloss rating of 5 - 20.
9. Fabrication Tolerances:
   a. Variation in Component Size: +/-1/8".
   b. Location of Openings: +/-1/8" from indicated location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. Verify actual site dimensions and location of adjacent materials prior to commencing work.
   3. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within 1/8" in 10' - 0".
   4. Notify Architect in writing of any conditions which would be detrimental to installation.

B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2 INSTALLATION

A. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed Shop Drawings and Product installation details.

B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.

C. Route radii and contours to template. Anchor securely to base component or other supports. Align adjacent components and form seams to comply with manufacturer’s written recommendations

using adhesive in color to match work. Carefully dress joints smooth, remove surface scratches and clean entire surface.

D. Install countertops with no more than 1/8" sag, bow or other variation from a straight line.

E. Adhere undermount/submount/bevel mount sinks/bowls to countertops using manufacturer's recommended adhesive and mounting hardware.

F. Seal between wall and components with joint sealant as specified herein and in Section 07 92 00, as applicable.

G. Provide backsplashes and end splashes as indicated on Drawings. Adhere to countertops using a standard color-coordinated silicone sealant. Adhere applied sidesplashes to countertops using a standard color-matched silicone sealant. Provide coved backsplashes and sidesplashes at walls and adjacent millwork. Fabricate radius cove at intersection of counters with backsplashes to dimensions shown on reviewed Shop Drawings. Adhere to countertops using manufacturer’s standard color-coordinated joint adhesive.

H. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Ensure components are clean on date of Substantial Completion of the Work.

I. Coordinate connections of plumbing fixtures with Division 22 Mechanical. Make plumbing connections to sinks in accordance with Division 22 Mechanical.

3.3 REPAIR

A. Repair minor imperfections and cracked seams and replace areas of severely damaged surfaces in accordance with manufacturer’s “Technical Bulletins”.

3.4 SITE QUALITY CONTROL

A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.5 CLEANING

A. Clean work under provisions of Division 1 – General Requirements.

B. Clean surfaces in accordance with manufacturer’s “Care and Maintenance Instructions”.

3.6 PROTECTION

A. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.

B. Protect surfaces from damage until date of Substantial Completion of the Work.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Thermal insulation throughout the Project.

B. Principal Products:

1. Foam board insulation.
2. Blanket insulation.
3. Insulation accessories.

1.2 ACTION SUBMITTALS

A. Product Data.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

1. Thermal performance.
2. Surface burning characteristics.
3. Combustibility.
4. Density.

1.4 QUALITY ASSURANCE

A. Certifications: From Contractor for specified tolerances.

B. Mockups: Construct a comprehensive mockup of each type of insulation. Demonstrate product interfaces, intersections, and terminations.

1. Mockups Location: Field.
2. Approved mockups establish products and work results standard.
3. Approved mockups may remain a part of the work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store insulation in dry location, protected from elements.
2. Handle insulation to prevent soiling and damage.
3. Foam Board Insulation:

a. Protect combustible insulation against ignition.

PART 2 - PRODUCTS

2.1 FOAM BOARD INSULATION

A. Extruded Polystyrene Board: ASTM C578.

1. Manufacturers and Products:

a. DiversiFoam Products CertiFoam 25.
b. DuPont STYROFOAM.
c. GreenGuard Type IV 25 psi XPS Insulation Board.
d. Owens Corning FOAMULAR 250.
e. Or approved equal.

2. Type IV, 25 psi, square edges.
3. Surface Burning Characteristics: ASTM E84:

a. Flame Spread Index: 25, maximum.
b. Smoke Developed Index: 450, maximum.

B. Extruded Polystyrene Drainage Board: ASTM C578.

1. Manufacturers and Products:

a. DiversiFoam Products CertiFoam Drainage Board.
b. DuPont STYROFOAM PERIMATE.
c. GreenGuard XPS Drainage Channel Board.
d. Owens Corning FOAMULAR PINK-DRAIN.
e. Or approved equal.

2. Type IV, 25 psi.
3. Edges: Shiplap or channel.
4. Outer Face: Fabricated with drainage channels.

2.2 BLANKET INSULATION

A. Unfaced Glass-Fiber Blankets: ASTM C665, Type I.

1. Manufacturers and Products:

a. CertainTeed Corporation Fiber Glass Building Insulation.
b. Johns Manville Unfaced Fiber Glass Batts.
c. Knauf Insulation EcoBatt Insulation.
d. Owens Corning EcoTouch Pink.
e. Or approved equal.

2. Surface Burning Characteristics: ASTM E84:

a. Flame Spread Index: 25, maximum.
b. Smoke Developed Index: 50, maximum.

3. Combustion: Passes ASTM E136.

B. Faced Glass-Fiber Blankets: ASTM C665, vapor-retarding.

1. Manufacturers and Products:

a. CertainTeed Corporation CertaPRO.
b. Johns Manville Faced Batts.
c. Knauf Insulation EcoBatt Insulation.
d. Owens Corning EcoTouch Pink.
e. Or approved equal.

2. Facing: One side, Kraft.
3. Surface Burning Characteristics: ASTM E84:

a. Flame Spread Index: 25, maximum.

C. Unfaced Mineral-Fiber Blankets: ASTM C665, Type I.

1. Manufacturers and Products:

a. Johns Manville TempControl Mineral Wool.
b. Owens Corning Thermafiber UltraBatt.
c. Rockwool COMFORTBATT
d. Or approved equal.

2. Surface Burning Characteristics: ASTM E84:

a. Flame Spread Index: 25, maximum.
b. Smoke Developed Index: 50, maximum.

3. Combustion: Passes ASTM E136.
4. Postconsumer Plus One-Half Preconsumer Recycled Content: 35 percent, minimum.

2.3 INSULATION FASTENERS

A. Spindle-Type Adhered Anchors: Galvanized steel plate with galvanized or copper-coated steel spindle.

1. Manufacturers and Products:

a. AGM Industries.
b. Gemco.
c. Gripnail
d. Midwest Fasteners.
e. Or approved equal.

2. Spindle Length: Suited to insulation depth.

B. Insulation-Retaining Washers: Galvanized steel self-locking washers.

1. Washer Size: Recommended by anchor manufacturer.

C. Insulation Standoffs: Galvanized steel spacer fit over spindle providing space between insulation and substrate.

D. Anchor Adhesive: Type recommended by anchor manufacturer for substrate.

2.4 INSULATION ADHESIVES

A. Adhesive: Product compatible with insulation and substrates, capable of securing insulation to substrate without damaging insulation or substrates.

2.5 ACCESSORIES

A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets sized to fit between roof framing members over eave vents.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates and remove projections and appurtenances that may damage insulation or inhibit adhesion.

3.2 INSTALLATION - GENERAL

A. Extend insulation to cover entire area shown to be insulated.

B. Insulate tightly around obstructions and penetrations.

C. Fill voids with compressed fibrous insulation.

D. Foam Board Insulation: Protect from extended sunlight exposure beyond manufacturer stated limits.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. Horizontal Surfaces: Loosely lay insulation with units butted tightly. Stagger end joints.

1. Insulation Coverage: Entire surface.
2. Insulation Coverage: Extend 24 inches from exterior walls.

B. Vertical Surfaces: Fully adhere insulation with units butted tightly.

1. Adhere insulation boards with mastic recommended by insulation manufacturer for use with required waterproofing membrane.
2. Lap fabric facing over adjacent insulation boards and pin or tape in place to prevent displacement during backfilling.
3. Close drainage channels at top edge with metal flashing or additional fabric pinned in place to prevent soil from entering drainage channels.
4. Connect panels to subsurface drainage system.

3.4 INSTALLATION OF FRAMED WALL INSULATION

A. Blanket Insulation: Fill cavities between framing members with insulation. Snugly fit insulation.

1. Recessed Lighting Fixtures: Maintain 3-inch clearance between insulation and fixtures not rated for insulation contact.
2. Eave Ventilation: Install eave ventilation troughs between roof framing members at vented eaves.
3. Metal-Framed Wall Cavities over 96 Inches High:

    a. Faced Blankets: Tape flanges to stud faces.
    b. Unfaced Blankets: Apply insulation fasteners to stud faces before installing insulation.

4. Wood-Framed Construction: ASTM C1320.

    a. Rafter and Joist Installation: Support insulation 24 inches on center, maximum and within 12 inches of each blanket end.
    b. Faced Blankets: Overlap and staple facing flanges to framing members. Tape joints and holes in facing.

3.5 PROTECTION

A. Protect insulation from damage due to weather, ultraviolet radiation, physical abuse, and other causes. Provide temporary coverings or enclosures until permanent construction is completed.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Air barriers.

B. Principal Products:

1. Air barrier membrane.
2. Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate air barrier installation with roofing, wall openings, and waterproofing installation.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Air barrier membrane.
2. Primers.
3. Preformed silicone seals.

B. Shop Drawings:

1. Locations and extent of air barriers.
2. Termination conditions.
3. Gap and expansion joint bridging.
4. Interface with other assemblies and materials.
5. Outside corners.
6. Penetration sealing.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Certify air barrier membrane chemical and adhesive compatibility with adjacent and contacted materials.

B. Test and Evaluation Reports: Manufacturer test results showing:

1. Performance.

C. Field Quality Control Submittals: Mock-up test reports.

D. Qualification Statements: testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For air barrier.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers:

a. Air Barrier Subcontractor: Accredited by ABAA.
b. Individual Installers: Certified by Building Performance Quality Institute for the ABAA in accordance with its Site Quality Assurance Program.

2. Testing Agencies: Acceptable to authorities having jurisdiction.

B. Joint Sealant Testing: Test joint sealants for adhesion to air barrier membrane per ASTM C794.

C. Mock-ups: Construct field mock-up of air barrier assembly including backup wall, typical penetrations, and glazing assemblies. Demonstrate product interfaces, intersections, and terminations.

D. Preconstruction Mock-up Testing: Test wall mock-ups. Complete testing 30 days, minimum, before scheduled field installation.

1. Air Leakage Testing: ASTM E1186 and ASTM E786 at 6.24 lb/sf ft.
2. Adhesion Testing: ASTM D4541.
3. Water Penetration Testing: ASTM E1105.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material manufacturer.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Perform work within the following limitations.

1. Ambient and Surface Temperature: Within manufacturer acceptable range.
2. Precipitation and Fog: None occurring.

1.9 WARRANTY

A. Installer Warranty:

1. Air Barrier Assembly: Warrant against installation failure.

a. Failure includes loss of air-tight seal, loss of watertight seal, and adhesion failure.
b. Warranty Period: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Source Limitations: Obtain accessory products from same manufacturer as primary air barrier.

Note: All products approved as an equal shall only be accepted subject to full compliance with all applicable performance requirements and subject to the manufacturer's assurance of compatibility with all adjacent materials. Systems shall incorporate product components that are single-source, meaning either from a single manufacturer or from a family of manufacturer-approved compatible products.

2.2 VAPOR-RETARDING FLUID-APPLIED MEMBRANE AIR BARRIER

A. Vapor-Retarding Air Barrier: Synthetic polymer fluid-applied membrane.

1. Manufacturers and Products:

a. Carlisle Coatings & Waterproofing Fire Resist Barritech VP.
b. GCP Applied Technologies Perm-A-Barrier Liquid VPL-50.
c. Henry Company Air-Block 32MR.
d. Air Shield LMP (liquid membrane permeable) by W.R. Meadows.
e. Or approved equal.

2. VOC Content: 100 g/L, maximum.
3. Accessories: Provide primers, flashing, joint treatments, and transition membranes manufactured or approved in writing for use by air barrier material manufacturer.

2.3 VAPOR-RETARDING SHEET MEMBRANE AIR BARRIER

A. Air Barrier: Self-adhering air barrier membrane.

1. Manufacturers and Products:

a. Henry Company Blueskin SA as basis of design LT.
b. 3M Air Barrier 3015.
c. Carlisle Fire Resist 705 FR-A.
d. GCP Applied Technologies PERM-A-BARRIER.
e. Tremco ExoAir 110.
f. AIR SHIELD (air and vapor barrier membrane) by W.R. Meadows.
g. Or approved equal.

2. Tensile Strength: 250 psi minimum, per ASTM D882.
3. Puncture Resistance: 40 lbf, minimum, per ASTM E154.
4. Accessories: Provide primers, flashing, joint treatments, and transition membranes manufactured or approved in writing for use by air barrier material manufacturer.

2.4 TRANSITION SEALERS

A. Transition Assemblies and Joint Sealants: Section 079200.

B. Preformed Silicone Seals: Low-modulus silicone extrusions.

1. Manufacturers and Products:

a. Dow Chemical DOWSIL 123.
b. GE Sealants US11000 UltraSpan.
c. Pecora Corp Sil-Span.
d. Tremco Spectrem Simple Seal.
e. Or approved equal.

2. Color: Architect selected.
3. Adhesive: Medium or low-modulus silicone sealant recommended by preformed silicone seal manufacturer.

2.5 PERFORMANCE

A. Environmental Performance: Continuous weather-resistive assembly acting in conjunction with adjacent materials to resist air and water leakage into the building and to function as a drainage plane for incidental moisture.

1. Air Infiltration:

a. Material: 0.004 cfm/sf at a pressure differential of 1.57 lb/sq ft per ASTM E2357.
b. Assembly: 0.04 cfm/sf at 1.57 lb/sq ft per ASTM E2357.

2. Vapor Permeance: 10 perms, minimum per ASTM E96 Desiccant Method.

B. Fire Resistance: Tested as a component of assembly passing NFPA 285.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces are sound, dry, even, and free of contaminants.

B. Masonry Substrates: Verify masonry joints are flush and completely filled and excess mortar is removed from veneer ties.

3.2 PREPARATION

A. Protection of In-Place Conditions: Mask and cover adjacent areas to protect from over-spray.

B. Surface Preparation: Clean and prepare substrate.

1. Ensure that penetrating work is in place and complete.
2. Prepare surfaces by removing loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants.

C. Priming: Prime substrate.

3.3 INSTALLATION - GENERAL

A. Coordinate the installation of air barrier membrane with other building elements.

1. Connect air barrier to roofing and below-grade waterproofing and roofing systems.
2. Connect and seal air barrier material to exterior systems.

B. Fluid-Applied Air Barrier Installation: Install air barrier accessories and fluid-applied membrane to provide continuity throughout the building envelope.

C. Sheet Membrane Air Barrier Installation: Adhere sheet membrane to substrate; ensure continuous air barrier configured to direct moisture to exterior.

D. Substrate Gaps and Joints: Bridge with manufacturer recommended transition membrane.

1. Seal around penetrations with sealant.
2. End of Day Procedure: Seal top edge of membrane with termination mastic.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.

B. Inspections: Inspections may include the following:

1. Substrate preparation and priming completed correctly.
2. Continuity of air barrier.
3. Support of air barrier against substrate.
4. Site conditions maintained within manufacturer limits.
5. UV Exposure below manufacturer limits.
6. Proper installation of air barrier.
7. Compatible materials have been used.
8. Transitions at changes in direction and structural support at gaps have been provided.
9. Connections between assemblies completed correctly.
10. All penetrations have been sealed.

C. Tests: Tests may include the following:

1. Air-Leakage Location Testing: Testing per ASTM E1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage Volume Testing: Testing per ASTM E783.
3. Adhesion Testing: Testing per ASTM D4541.

D. ABAA Installer Audits: Cooperate with ABAA testing agency. Allow access to work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site audits by ABAA to verify conformance with the material manufacturer instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

1. If the inspections reveal any defects, promptly remove and replace defective work.

E. Non-Conforming Work: Make corrections or replace, and re-test.

F. Manufacturer Services.

3.5 CLEANING

A. Cleaning: Clean spillage from adjacent construction.

3.6 PROTECTION

A. Protection: Protect air barrier materials from damage until material is covered by permanent construction.

1. Coordinate installation of façade materials to ensure exposure period does not exceed that recommended by membrane manufacturer.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Standing seam metal roofing system.

B. Metal roofing accessories.

1.2 RELATED SECTIONS

A. Section 06 11 00 - Wood Framing.

B. Section 06 15 00 - Wood Decking.

C. Section 07 62 00 - Sheet Metal Flashing and Trim.

D. Section 07 71 23 - Manufactured Gutters and Downspouts

1.3 REFERENCES

A. ASTM A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM B 101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.

D. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

E. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

F. ASTM D 1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

G. ASTM D 3575 - Standard Test Methods for Flexible Cellular Materials made from Olefin Polymers.

H. ASTM E 84 - Standard Test for Surface Burning Characteristics of Building Materials.

I. ASTM E 283 - Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

J. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

K. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

L. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

M. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.

N. ASTM E 2140 - Standard Test Method for Water Penetration of Metal Roof Panel Systems

by Static Water Pressure Head.

O. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.

P. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

Q. FM 4470 Approval Standard for Class 1 Panel Roofs.

R. FM 4471 - Class 1 Panel Roof; Factory Mutual Research Corporation.

S. UL 263 - Fire Tests of Building Constructions and Materials.

T. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.

U. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.

V. UL 1897 - Uplift Test for Roof Covering Systems.

W. ICC-ES AC166 - Test Procedure for Wind Driven Rain Resistance of Metal Roof Coverings.

X. SMACNA - Architectural Sheet Metal Manual.

Y. National Coil Coating Association (NCCA)

Z. NRCA - The NRCA Roofing and Waterproofing Manual.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Standing Seam Roofing System:
   1. Thermal Expansion and Contraction:
      a. Completed metal roofing and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.
      b. Design temperature differential shall be not less than 200 degrees F.
      c. Interface between panel and clip shall provide for unlimited thermal movement in each direction along the longitudinal direction.
      d. Location of metal roofing rigid connector shall be at roof ridge unless otherwise approved by the Architect. Metal ridge connector may require design as per job conditions by specified manufacturer.
   2. Uniform wind load capacity: Museum Building Roof
      a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
         1) Design Code: ASCE 7, Method 2 for Components and Cladding.
         2) Safety Factor: 1.67 after any load reduction or material stress increase.
         3) Category III Building with an Importance Factor of 1.
         4) Wind Speed: 126 mph.
         5) Exposure Category: C.
         6) Design Roof Height: 17 feet.
         7) Minimum Building Width: 42 feet.
         8) Roof Pitch: 6 inches per foot.
         9) Roof Area Design Uplift Pressure:
            a) Zone 1 - Field: 37.0 psf.
            b) Zone 2e – Eave: 37.0 psf.
            c) Zone 2n – Rake Edge: 55.1 psf.
            d) Zone 2r – Ridge: 55.1 psf
            e) Zone 3e – Corners @ Eave: 55.1 psf

f) Zone 3r – Corners @ Ridge: 75.0 psf

3. Uniform wind load capacity: Existing Building (Garage) Roof
   a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
      1) Design Code: ASCE 7, Method 2 for Components and Cladding.
      2) Safety Factor: 1.67 after any load reduction or material stress increase.
      3) Category III Building with an Importance Factor of 1.
      4) Wind Speed: 126 mph.
      5) Exposure Category: C.
      6) Design Roof Height: 18 feet.
      7) Minimum Building Width: 34 feet.
      8) Roof Pitch: 6 inches per foot.
      9) Roof Area Design Uplift Pressure:
         a) Zone 1 - Field: 37.5 psf.
         b) Zone 2e – Eave: 37.5 psf.
         c) Zone 2n – Rake Edge: 55.8 psf.
         d) Zone 2r – Ridge: 55.8 psf
         e) Zone 3e – Corners @ Eave: 55.8 psf
         f) Zone 3r – Corners @ Ridge: 75.9 psf
   b. ASTM E 1592: Capacity shall be determined using pleated airbag method in accordance with ASTM E 1592, testing of sheet metal roof panels. Allowable safe working loads shall be determined by dividing the ultimate test load by the safety factor specified above.
4. Uniform Positive Load Capacity.
   a. Dead Load: Loading of the roof structure, due to tear off of existing, and/or installation of new roofing materials shall not exceed the present loading due to weight of the existing roofing system.
5. Underwriters' Laboratories, Inc., (UL):
   a. Underwriters' Laboratories, Inc., (UL) Class A fire rating per UL 790.
6. ASTM E 1680: Static pressure air infiltration (roof panels):
   a. Pressure Leakage Rate
      1) 1.57 PSF 0.0054 cfm/sq.ft.
      2) 6.24 PSF 0.0054 cfm/sq.ft.
      3) 20.0 PSF 0.0027 cfm/sq.ft.
7. ASTM E 1646: Static pressure water infiltration (roof panels):
   a. Pressure Result:
      1) 5 Gal/Hr per S.F. and Static No Leakage
      2) Pressure of 20.0 Psf. for 15 minutes
8. Capacities for gauge, span or loading other than those tested may be determined by interpolation of test results within the range of test data. Extrapolation for conditions outside test range is not acceptable.
9. Submit third party validation of environmental claims, prepared UL Environment, for all metal roof panels containing recycled content and/or bio based content.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Submit product data, test reports, and certifications in accordance with quality assurance and performance requirements specified herein.

C. Design Loads: Submit manufacturer's minimum design load calculations according to ASCE 7, Method 2 for Components and Cladding. In no case shall the design loads be taken to be less than those specified herein.

D. Shop Drawings: Prepared specifically for this project; showing dimensions of metal roofing

and accessories, fastening details and connections and interface with other products.

E. LEED Submittals: Provide documentation of how the requirements of Credit will be met:
   1. List of proposed materials with recycled content. Indicate post-consumer recycled content and pre-consumer recycled content for each product having recycled content.
   2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.

F. Selection Samples: For each finish product specified, two complete sets of samples representing manufacturer's full range of available colors and textures.

G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and textures.

H. Closeout Submittals:
   1. Provide manufacturer's maintenance instructions that include recommendations for periodic checking and maintenance of installed roof system.
   2. Provide executed copy of manufacturer's warranty.

1.6 QUALITY ASSURANCE

A. Engage the Manufacturer’s Field Representative to conduct required inspections of work in progress. Manufacturer shall provide a site inspection 3 days per week minimum that confirms that the project is being constructed as specified, by an experienced, full time employee of the company. Manufacturer shall submit reports and photographic documentation to the Owner and/or Architect confirming the roof installation has been completed according to project specifications and manufacturer’s warranty requirements.

B. Manufacturer Qualifications: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.

C. Installer Qualifications: Certified and approved installer of the sheet metal roofing manufacturer.

1.7 PRE-INSTALLATION CONFERENCE

A. Convene a pre-roofing conference approximately two weeks before scheduled commencement of roofing system installation and associated work.

B. Require attendance of installers of deck or substrate construction to receive roofing, installers of rooftop units and other work in and around roofing which must precede or follow roofing work including mechanical work, Architect, Owner, and roofing system manufacturer's representative.

C. Objectives include:
   1. Review foreseeable methods and procedures related to roofing work, including set up and mobilization areas for stored material and work area.
   2. Tour representative areas of roofing substrates, inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work.
   3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
   4. Review roofing system requirements, Drawings, Specifications and other Contract Documents.
   5. Review and finalize schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
   6. Review required inspection, testing, certifying procedures.

7. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing.
8. Record conference including decisions and agreements reached. Furnish a copy of records to each party attending.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
1. Store materials above ground, on skids.
2. Protect material with waterproof covering and allow sufficient ventilation to prevent condensation buildup or moisture entrapment on the materials.
3. Manufacturer's product crates are designed for transportation only, not intended for loading materials to roof.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. Required Warranty: 30-year Warranty
1. Provide roof system manufacturer’s 30-year limited watertight warranty.
2. Provide installers 5-year minimum warranty covering roofing system installation and water-tightness.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:
1. Garland Company, Inc.
2. Approved Equal

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 STANDING SEAM METAL ROOFING

A. R-Mer Loc: Panel with 1-3/4 inch high standing seam with 3/16-inch high clearance between panel and substrate.
1. Width of Panel:
a. 16 inches.
2. Seam Height: 1-3/4 inch.
3. Slope: Open Purlins, Slopes down to 3:12.
4. Slope: Solid Substrate, no framing components, Slopes down to 1-1/2 :12.
5. Panel Clips: Single piece, 18 gauge minimum, galvanized steel or stainless steel. Two-piece clips are unacceptable.
6. Passes:
a. ASTM E 1592
b. ASTM E 1680
c. ASTM E 1646
d. Class A Fire Rating, UL-790.

e. UL (Class 90) 580.

7. Panel material:
   a. Galvanized steel 22 gauge, G90, smooth as per ASTM A 653.
8. Flashing and flat stock material: Fabricate in profiles indicated on Drawings of same material, thickness, and finish as roof system, unless indicated otherwise.
9. Coated Finish:
   a. Exposed surfaces for coated panels:
      1) Two coat coil applied, baked-on full-strength (70% resin) fluorocarbon coating system (polyvinylidene fluoride, PVF2), applied by manufacturer's approved applicator.
      2) Coating system shall provide nominal 1.0 mil dry film thickness, consisting of primer and color coat.
   b. Unexposed surfaces for coated panels shall be baked-on polyester coating with .20 to .30 dry film thickness (TDF).
10. Accessory Components:
   a. Gable anchor clips shall be minimum 18 gauge, galvanized steel or stainless steel.
   b. Fasteners:
      1) Concealed fasteners: Corrosion resistant steel fasteners (zinc plated or equal) designed to meet structural loading requirements. Provide #14 as minimum fastener size.
      2) Exposed fasteners: Series 410 stainless steel fasteners or one-eighth (1/8) inch diameter stainless steel waterproof rivets. All exposed fasteners shall be factory painted to match the color of the standing seam panels.
   c. Closures: Factory precut closed cell foam meeting ASTM D 1056 or ASTM D 3575, with metal trim matching panels when used at hip, ridge, jamb, and rake.
   d. Provide all miscellaneous accessories for complete installation.

2.3 METAL ROOFING ACCESSORIES

A. Underlayment:
   1. 45 mil minimum, high temperature, self-adhesive membrane, vapor impermeable and self-sealing, installed in accordance with manufacturer's recommendations.
      a. Vapor Permeance ASTM E 96): < .02
      b. Tensile Strength (ASTM D 1970): MD 32 lbs/in, XD 35 lbs/in
      c. Nail Sealability (ASTM D 1970): Pass

B. R-Mer SS Sheet Stock: High gloss, factory painted steel
   1. Material and Thickness:
      a. 22 gauge steel

C. Sealant:
   1. Concealed Applications: Non-Curing Butyl Sealant - Schnee-Morehead, Inc. SM5430 Acryl-R, or equal.
   2. Exposed Applications: UV Resistant Tripolymer Sealant - Geocel Corporation, 2300 Tripolymer Sealant, or equal.

D. Gutters
   1. Gutter material: .040 aluminum painted to match roof panel.
   2. Gutters are to be single piece lengths fabricated as required to meet the drainage capacity of the roof system.
   3. Gutter brackets are to be a minimum of 3/16” x 1” aluminum.
   4. Gutters are to be supported by brackets spaced 36” on center minimum. Gutters shall be further supported by spacers every 36” on center and spaced alternately with brackets.

E. S-5! Snow Retention System: Compatible with specified R-Mer Loc metal panel system.
   1. Roof attachment clamps: Provide aluminum standing steam roof clamp. Carbon steel or plastic parts are not acceptable. No fastener penetrations of the roof will be permitted. Clamp to attach to the standing seam will have two stainless steel set screws (3/8” minimum diameter) having rounded point. One clamp shall be installed per standing seam for each row.
   2. Cross member: Extrusion with receptacle in face to provide for insert of color strip. Color strip is to be the same pre-finished material and originate from the same supplier as the roof panels. Cross member is to be continuous and include splice connectors to join adjacent sections, ensuring alignment and structural continuity. Cross member is attached to clamps using 3/8" diameter stainless steel bolts.
   3. Snow/ Ice Clips: "Snow Clips" are to be aluminum or stainless steel, with rubber "foot". Clip to attach to cross member and rest on panel flat, between panel seams to retard movement of snow/ice beneath cross member. Use one clip per panel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive metal roofing. Notify the Architect in writing of any defective conditions encountered. Starting of work shall constitute acceptance of such conditions.

B. Structural Deck Substrate:
   1. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped.
   2. Verify deck is dry and joints are solidly supported and fastened.
   3. Verify wood nailers are installed and correctly located. Do not use pressure-treated wood containing salt-based preservatives or materials corrosive to steel.

C. Structural Framing Substrate:
   1. Verify primary and secondary framing members are installed and fastened, properly aligned and sloped.
   2. Verify damaged shop coatings are repaired with touch up paint.

D. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.

E. Correct defective conditions before beginning work.

3.2 INSTALLATION

A. Install metal roof system in conformance with the NRCA Roofing and Waterproofing Manual, SMACNA Architectural Sheet Metal Manual, Manufacturers approved shop drawings and installation requirements.

B. Manufacturer to provide panels specific to the project. Fabrication of the panels by the installing contractor is prohibited.

C. Establish straight side and crosswise benchmarks.

D. Measure the roof lengthwise to confirm panel lengths, Rectangular roofs shall be checked for square and straightness. Gable ends may not be straight; set a true line for the gable clips and flashing with a stringline. overhangs, coverage of flashings at eaves and ridges and verify clearances for thermal movement.

E. Form panel shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.

F. Install underlayment and eave protection sheet underlayment as recommended by the Manufacturer.
   1. Starting at low point, position membrane into place and peel back release liner. Press membrane to substrate surface to activate adhesive backing. Roll surface of sheet to fully engage adhesive.
   2. Install subsequent rolls shingle fashion, rolling each sheet to promote adhesion. Particular attention is required at laps to ensure complete seal. Overlap end laps by 6” minimum, overlap side laps 3” minimum.

G. Install all panels continuous from ridge to eave. Transverse seams are not permitted.

H. Exposed fasteners, screws and/or roof mastic are unacceptable and will be rejected. System configuration only allows for exposed fasteners at panel overlap, if required, and at trim details in accordance with the Manufacturer's requirements.

I. Attach the panel clips to the roof deck. Anchorage shall allow for temperature expansion/contraction movement without stress or elongation of panels, clips, or anchors. Attach clips to structural substrate using fasteners of size and spacing as determined by manufacturer's design analysis to resist specified uplift and thermal movement forces.

J. Clip spacing shall be determined by roof system manufacturer’s wind calculations and approved shop drawings.
   1. Museum Building Roof
      a. Zone 1 - Field: 3’1” max spacing.
      b. Zone 2e – Eave: 3’1” max spacing.
      c. Zone 2n – Rake Edge: 2’0” max spacing.
      d. Zone 2r – Ridge: 2’0" max spacing.
      e. Zone 3e – Corners @ Eave: 2’0" max spacing.
      f. Zone 3r – Corners @ Ridge: 1’6” max spacing
   2. Garage Building Roof
      a. Zone 1 - Field: 2’0” max spacing.
      b. Zone 2e – Eave: 2’0” max spacing.
      c. Zone 2n – Rake Edge: 1’4” max spacing.
      d. Zone 2r – Ridge: 1’4" max spacing.
      e. Zone 3e – Corners @ Eave: 1’4" max spacing.
      f. Zone 3r – Corners @ Ridge: 1’0” max spacing
      g.

K. Installation of Roof Panels: Roof panels can be installed starting from either end and working towards the opposite end. Follow roof system manufacturer’s instructions and shop drawings for all detailing of flashings and trim components.

L. Where not otherwise indicated conform to SMACNA details including flashings and trim. Coordinate flashing and sheet metal work to form weathertight conditions at roof terminations.

M. Install sealants where indicated to clean dry surfaces only without skips or voids.

N. Install metal edge treatment in accordance with the manufacturer's instructions and the approved shop drawings.

O. Install metal roofing accessories in accordance with the manufacturer's instructions and the approved shop drawings.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Exterior, panelized fiber cement cladding system and accessories to complete a drained and back-ventilated rainscreen.

1.2 RELATED SECTIONS

A. Section 05 41 00 - Structural Metal Stud Framing

B. Section 06 10 00 - Rough Carpentry

C. Section 06 16 00 - Sheathing

D. Section 07 20 00 - Thermal Protection

E. Section 07 25 00 - Weather Barriers

F. Section 07 60 00 - Flashing and Sheet Metal

G. Section 07 90 00 - Joint Protection

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 509 – Voluntary Test and Classification Method of Drained and Back Ventilated Rain Screen Wall Cladding Systems

B. ASTM International (ASTM):

1. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C1186 – Standard Specification for Flat Fiber-Cement Sheets.

    a. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement.3. ASTM E84 - Standard Test for Surface Burning Characteristics of Building Materials.

3. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
4. ASTM E228 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer.
5. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
6. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

C. Florida Building Code - Test Protocol HVHZ

1. Testing Application Standard (TAS) 202, 203 – HVHZ Test Procedures

D. National Fire Protection Association (NFPA):

1. NFPA 285 - Fire Test Method for Exterior Wall Assemblies Containing Combustible Material.
2. NFPA 268 – Ignition Resistance of Exterior Wall Assemblies.

E. Standards Council of Canada & Underwriters Laboratories Canada (ULC):

1. CAN/ULC S102 – Standard Method of Test for Surface Burning Characteristics.
2. CAN/ULC S134 – Standard Method of Fire Test of Exterior Wall Assembly.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Submit manufacturer's product description, storage and handling requirements, and installation instructions.

C. Product Test Reports and Code Compliance: Documents demonstrating product compliance with local building code, such as test reports or Evaluation Reports from qualified, independent testing agencies.

D. Manufacturer's Details: Submit drawings (.dwg, .rvt, and/or .pdf formats), including plans, sections, showing installation details that demonstrate product dimensions, edge/termination conditions/treatments, compression and control joints, corners, openings, and penetrations.

E. Samples: Submit samples of each product type proposed for use.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. All fiber cement panels specified in this section must be supplied by a manufacturer with a minimum of 10 years of experience in fabricating and supplying fiber cement cladding systems.
2. Provide technical and design support as needed regarding installation requirements and warranty compliance provisions.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer trained by a manufacturer or representative.

C. Mock-Up Wall: Provide a mock-up wall as evaluation tool for product and installation workmanship.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Panels must be stored flat and kept dry before installation. A waterproof cover over panels and accessories should be used at all times prior to installation. Do not stack pallets more than two high. Refer to the information included on each pallet.

B. If panels are exposed to water or water vapor prior to installation, allow to completely dry before installing. Failure to do so may result in panel shrinkage at ship lap joints, and such action may void warranty.

C. Panels MUST be carried on edge. Do not carry or lift panels flat. Improper handling may cause cracking or panel damage.

D. Direct contact between the panels and the ground should be avoided at all times. It is necessary to keep panels clean during installation process.

1.7 WARRANTY

A. Provide manufacturer's 15-year warranty against manufactured defects in fiber cement panels. Additional 5-year extension available when refinished in year 14-15.

B. Provide manufacturer's 15-year warranty against manufactured defects in panel finish.

C. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. A. Acceptable Manufacturers:

1. Nichiha USA, Inc., 3150 Avondale Mill Rd, Macon, GA 301216, USA
2. Nichiha Corporation, 18-19 Nishiki 2-chome Naka-ku, Nagoya, Aichi 460-8610, Japan.

B. Acceptable Manufacturer's Representative: Nichiha USA, Inc., 6465 E. Johns Crossing, Suite 250, Johns Creek, GA 30097. Toll free: 1.866.424.4421, Office: 770.805.9466, Fax: 770.805.9467, www.nichiha.com.

1. Basis of Design Product: Nichiha VintageWood.

a. Profile colors: Bark, Cedar, Redwood, Ash, and Spruce.
b. Profiles: Wood plank texture with three, 3/8" grooves running lengthwise, spaced 5-5/8" apart.
c. Accessory/Component Options:

1) Manufactured Corners with 3-1/2" returns for each profile color.
2) Aluminum trim options: Corner Key, Open Outside Corner, H-Mold, J-Mold, Compression Joint, Inside Corner

a) Finish: Bark, Cedar, Clear Anodized, or Primed.

3) Essential Flashing System: Starter, Overhang.

a) Finish: Matte black.

d. Dimensions:

1) AWP-1818: 455mm (17-7/8”) (h) x 1,818 mm (71-9/16”) (l).
2) AWP-3030: 455mm (17-7/8”) (h) x 3,030 mm (119-5/16”) (l).

e. Panel Thickness: 16 mm (5/8").
f. Weight: AWP-1818: 35.27 lbs. per panel, AWP-3030: 57.32 lbs. per panel.
g. Coverage: 8.88 sq. ft. per panel (1818), 14.81 sq. ft. per panel (3030).
h. Factory sealed on six [6] sides.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 MATERIALS

A. Fiber cement panels manufactured from a pressed, stamped, and autoclaved mix of Portland cement, fly ash, silica, recycled rejects, and wood fiber bundles.

B. Panel surface pre-finished and machine applied.

C. Panels profiled along 3030mm edges so that the long joints between the installed panels are ship-lapped.

D. Factory-applied sealant gasket added to top panel edge; all 3030mm edge joints contain a factory sealant.

2.3 PERFORMANCE REQUIREMENTS:

A. A. Fiber Cement Cladding – Must comply with ASTM C1186, Type A, Grade II requirements:

1. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement:

a. Wet Flexural Strength: Result: 1418 psi, Lower Limit: 1015 psi.
b. Water Tightness: No water droplets observed on any specimen.
c. Freeze-thaw: No damage or defects observed.
d. Warm Water: No evidence of cracking, delamination, swelling, or other defects observed.
e. Heat-Rain: No crazing, cracking, or other deleterious effects, surface or joint changes observed in any specimen.

B. Mean Coefficient of Linear Thermal Expansion (ASTM E228): Max 1.0*10^-5 in./in. F.

C. Surface Burning (CAN-ULC S102/ASTM E84): Flame Spread: 0, Smoke Developed: 0.

D. Wind Load (ASTM E330): Contact manufacturer for ultimate test pressure data corresponding to framing type, dimensions, fastener type, and attachment clips. Project engineer(s) must determine Zone 4 and 5 design pressures based on project specifics.

1. Minimum lateral deflection: L/120.

E. Water Penetration (ASTM E331): No water leakage observed into wall cavity.

F. Steady-State Heat Flux and Thermal Transmission Properties Test (ASTM C518): 16mm thick panel thermal resistance R Value of 0.47.

G. Fire Resistant (ASTM E119): The wall assembly must successfully endure 60-minute fire exposure without developing excessive unexposed surface temperature or allowing flaming on the unexposed side of the assembly.

H. Ignition Resistance (NFPA 268): No sustained flaming of panels, assembly when subjected to a minimum radiant heat flux of 12.5 kW/m2 ± 5% in the presence of a pilot ignition source for a 20-minute period.

I. Fire Propagation (NFPA 285): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Commercial Wrap, ½" Densglass Gold Sheathing, 16" o.c. 18 gauge steel studs, mineral wool in-cavity insulation, and interior 5/8" Type X gypsum met the acceptance criteria of NFPA 285.

J. J. Fire Propagation (CAN/ULC S134): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Housewrap, 5/8" FRT plywood, 16" o.c. 2x wood studs, fiberglass in-cavity insulation, and interior 5/8" Type X gypsum met the acceptance criteria of CAN/ULC S134.

K. Drained and Back Ventilated Rainscreen (AAMA 509): System classifications: W1, V1.

L. Florida Building Code - Test Protocol HVHZ (TAS 202, 203): Horizontal Application Design Pressure: 95 psf, Vertical Application Design Pressure: 85 psf.

2.4 INSTALLATION COMPONENTS

A. Ultimate Clip System:

1. Starter Track:

    a. Horizontal Panel Installations - FA 700 – 3,030mm (l) galvalume coated steel.
    b. Vertical Panel Installations (AWP-3030 only) – FA 710T – 3,030mm (l) galvalume coated steel.

2. Panel Clips: JEL 778 "Ultimate Clip II" (10mm rainscreen for 16mm AWP) – Zinc-Aluminum-Magnesium alloy coated steel.

    a. Joint Tab Attachments (included) – used at all AWP-1818 panel to panel vertical joints, NOT used with AWP-3030 installations.

3. Corner Clips: JE 777C (10mm rainscreen for 5/8" AWP Manufactured Corners) -- Zinc-Aluminum-Magnesium alloy coated steel.
4. Single Flange Sealant Backer – FHK 1015 R (10mm) – 6.5' (l) fluorine coated galvalume.
5. Double Flange Sealant Backer – FH 1015 R (10mm) – 10' (l) fluorine coated galvalume.
6. Corrugated Spacer – FS 1005 (5mm), FS 1010 (10mm) – 4' (l).

B. Aluminum Trim (optional): Paint primed trim as specified in finish schedule.

C. Essential Flashing System (optional):

1. Starter – main segments (3,030mm), inside corners, outside corners
2. Overhang – main segments (3,030mm), inside corners, outside corners, joint clips

D. Fasteners: Corrosion resistant fasteners, such as hot-dipped galvanized screws appropriate to local building codes and practices must be used. Use Stainless Steel fasteners in high humidity and high-moisture regions. Panel manufacturer is not liable for corrosion resistance of

fasteners. Do not use aluminum fasteners, staples or fasteners that are not rated or designed for intended use. See manufacturer's instructions for appropriate fasteners for construction method used.

E. Flashing: Flash all areas specified in manufacturer's instructions. Do not use raw aluminum flashing. Flashing must be galvanized, anodized, or PVC coated.

F. Sealant: Sealant shall comply with ASTM C920, Class 35.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Fiber cement panels can be installed over braced wood, steel studs and sheathing including plywood, OSB, plastic foam (1" or less) or fiberboard sheathing. Fiber cement panels can also be installed over Structural Insulated Panels (SIP's), Concrete Masonry Units (CMU's) and Concrete Block Structures (CBS's) with furring strips, and Pre-Engineered Metal Construction. Insulated Concrete Forms (ICFs) require added measures. Consult with Nichiha Technical Services.
2. Allowable stud spacing: 16" o.c. maximum.
3. A weather resistive barrier is required when installing fiber cement panels. Use an approved weather resistive barrier (WRB) as defined by the IBC or IRC. Refer to local building codes.
4. Appropriate metal flashing should be used to prevent moisture penetration around all doors, windows, wall bottoms, material transitions and penetrations. Refer to local building codes for best practices.

B. Examine site to ensure substrate conditions are within alignment tolerances for proper installation.

C. Do not begin installation until unacceptable conditions have been corrected.

D. Do not install panels or components that appear to be damaged or defective. Do not install wet panels.

3.2 TOLERANCE

A. Wall surface plane must be plumb and level within +/- ¼ inch in 20 feet in any direction.

1. One layer of Nichiha 5mm (~3/16") Spacer may be used as shim.

3.3 INSTALLATION

A. General: Install products in accordance with the latest installation guidelines of the manufacturer and all applicable building codes and other laws, rules, regulations and ordinances. Review all manufacturer installation, maintenance instructions, and other applicable documents before installation.

1. Consult with your local dealer or Nichiha Technical Department before installing any Nichiha fiber cement product on a building higher than 45 feet or three stories or for conditions not matching prescribed standard installation guide requirements and methods. A Technical Design Review (TDR) process is available to evaluate project feasibility.
2. Vertical Control/Expansion Joints are required with AWP-1818, for walls wider than 30 feet, within 2-12 feet of outside corners finished with metal trim and approximately every 30 feet thereafter.

    a. Vertical Control/Expansion Joints are required at each AWP-3030 vertical joint, or H-Mold trim may be used instead.

3. Horizontal/Compression Joints are required for multi-story installations of AWP. Locate joints at floor lines. Joints are flashed minimum ½" breaks. Do not caulk. Refer to installation guide(s).

    a. Wood framed buildings of three or more floors require a compression joint at each floor.
    b. Steel framed buildings (including reinforced concrete core with LGMF exterior walls) of more than three floors (or 45 feet) require a compression joint every 25 feet at a floor line.

B. Panel Cutting

1. Always cut fiber cement panels outside or in a well ventilated area. Do not cut the products in an enclosed area.
2. Always wear safety glasses and NIOSH/OSHA approved respirator whenever cutting, drilling, sawing, sanding or abrading the products. Refer to manufacturer SDS for more information.
3. Use a dust-reducing circular saw with a diamond-tipped or carbide-tipped blade.

    a. Recommended circular saw: Makita 7-1/4" Circular Saw with Dust Collector (#5057KB).
    b. Recommended blade: Tenryu Board-Pro Plus PCD Blade (#BP-18505).
    c. Shears (electric or pneumatic) or jig saw can be used for complicated cuttings, such as service openings, curves, radii and scrollwork.

4. Silica Dust Warning: Fiber cement products may contain some amounts of crystalline silica, a naturally occurring, potentially hazardous mineral when airborne in dust form. Consult product SDS or visit https://www.osha.gov/dsg/topics/silicacrystalline/.
5. Immediately clean dust from cut panels as it may bind to the finish.

3.4 CLEANING AND MAINTENANCE

A. Review manufacturer guidelines for detailed care instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections apply to this section.

1.2 SUMMARY

A. Provide all labor, equipment, and materials to fabricate and install the following.

1. Edge strip and flashing.
2. Expansion joint and area divider covers.
3. Copings, fascia, trim and edge metal.

B. Related Work Specified Elsewhere:

1. Division 06 Section Rough Carpentry
2. Division 07 Section Roof Accessories
3. Division 07 Section Joint Sealants

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1.	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy-Coated (galvannealed) by the Hot-Dip Process.
2.	ASTM A792	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
3.	ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4.	ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
5.	ASTM D692	Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.

B. Warnock Hersey International, Inc., Middleton, WI (WH)

C. Factory Mutual Research Corporation (FMRC)

D. Underwriters Laboratories (UL)

E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

1. Architectural Sheet Metal Manual

F. National Roofing Contractors Association (NRCA).

1. Roofing and Waterproofing Manual

G. Single Ply Roofing Institute (SPRI).

1. Wind Design Guide for Use with Low Slope Roofing

1.4 SUBMITTALS FOR REVIEW

A. Product Data:

1. Provide manufacturer's specification data sheets for each product.
2. Metal material characteristics and installation recommendations.
3. Submit color chart prior to material ordering and/or fabrication so that equivalent colors to those specified can be approved.

B. Samples: Submit two (2) samples, illustrating typical metal edge, coping, gutters, fascia extenders for material and finish.

C. Shop Drawings:

1. For manufactured and shop fabricated gravel stops, fascia, scuppers, and all other sheet metal fabrications.
2. Indicate material profile, jointing pattern, jointing details, fastening methods, flashing, termination's, and installation details.
3. Indicate type, gauge and finish of metal.

D. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

1.5 SUBMITTALS FOR INFORMATION

A. Design and Test Reports: Provide the following certified test reports from an independent testing laboratory:

1. Independent laboratory testing report for system design load and seam integrity.
2. Professional engineer's documentation that system incorporates sufficient allowance for stress and movement.
3. A letter from an officer of the manufacturing company certifying that the materials furnished for this project are the same as represented in tests and supporting data.
4. Manufacturer's verifications that the panels are factory roll-formed.
5. UL 1897: Test report must be submitted for windstorm rating no less than that specified in Design and Performance Criteria article. The proposed roof system must have approval over specified substrate with steel framing spaced no further apart than as specified.

B. Mill production reports certifying that the steel thicknesses are within allowable tolerances of the nominal or minimum thickness or gauge specified.

C. Qualification Data for Installer. Refer to Quality Assurance Article below.

D. Certification of work progress inspection. Refer to Quality Assurance Article below.

E. Certifications:

1. Submit roof manufacturer's certification that metal fasteners furnished are acceptable to roof manufacturer.

2. Submit roof manufacturer's certification that metal furnished is acceptable to roofing manufacturer as a component of roofing system and is eligible for roof manufacturer's system warranty.

1.6 CONTRACT CLOSEOUT SUBMITTALS

A. General: Comply with Requirements of Section 01700 – Contract Closeout.

B. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.

C. Roofing Maintenance Instructions. Provide a manual of manufacturer’s recommendations for maintenance of installed roofing systems.

D. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.7 QUALITY ASSURANCE

A. Engage an experienced roofing contractor specializing in sheet metal flashing work with a minimum of five (5) years’ experience.

B. Maintain a full-time supervisor/foreman who is on the job-site at all times during installation. Foreman must have a minimum of five (5) years’ experience with the installation of similar system to that specified.

C. Source Limitation: Obtain components from a single manufacturer. Secondary products which cannot be supplied by the specified manufacturer shall be approved in writing by the primary manufacturer prior to bidding.

D. Upon request fabricator/installer shall submit work experience and evidence of financial responsibility. The Owner’s representative reserves the right to inspect fabrication facilities in determining qualifications.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened containers or packages with labels intact and legible.

B. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

1.9 PROJECT CONDITIONS

A. Determine that work of other trades will not hamper or conflict with necessary fabrication and storage requirements for pre-formed metal edge system.

1.10 DESIGN AND PERFORMANCE CRITERIA

A. Thermal expansion and contraction:

1. Completed metal edge flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability.

B. ANSI/SPRI ES-1 tested and approved.

1.11 WARRANTIES

A. Owner shall receive one (1) warranty from manufacturer of roofing materials covering all of the following criteria. Multiple warranties are not acceptable.

1. Pre-finished metal material shall require a written 20-year non-prorated warranty covering fade, chalking and film integrity. The material shall not show a color change greater than 5 NBS color units per ASTM D-2244 or chalking excess of 8 units per ASTM D-659. If either occurs material shall be replaced per warranty, at no cost to the Owner.
2. Changes: Changes or alterations in the edge metal system without prior written consent from the manufacturer shall render the system unacceptable for warranty(ies).
3. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.
4. The Contractor shall provide the Owner with a notarized written warranty assuring that all sheet metal work including caulking and fasteners to be watertight and secure for a period of two years from the date of final acceptance of the building. Warranty shall include all materials and workmanship required to repair any leaks that develop, and make good any damage to other work or equipment caused by such leaks or the repairs thereof.
5. Installing roofing contractor shall be responsible for the installation of the edge metal system in general accordance with the membrane manufacturer’s recommendations.
6. Installing contractor shall certify that the edge metal system has been installed per the manufacturer’s printed details and specifications.
7. One manufacturer shall provide a single warranty for all accessory metal for flashings, metal edges and copings, along with the warranty for metal roof areas, membrane roof areas, and any transitions between two different material types.

PART 2 PRODUCTS

2.1 PRODUCTS, GENERAL

A. Refer to Division 01 Section “Common Product Requirements.”

B. Basis of Design: Materials, manufacturer’s product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

C. Substitutions: Products proposed as equal to the products specified in this Section shall be submitted in accordance with Bidding Requirements and Division 01 provisions.

1. Proposals shall be accompanied by a copy of the manufacturer's standard specification section. That specification section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take

place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.

2. Include a list of three (3) projects of similar type and extent, located within a one hundred mile radius from the location of the project. In addition, the three projects must be at least five (5) years old and be available for inspection by the Architect, Owner or Owner's Representative.

3. Equivalency of performance criteria, warranty terms, submittal procedures, and contractual terms will constitute the basis of acceptance.

4. The Owner's decision regarding substitutions will be considered final. Unauthorized substitutions will be rejected.

2.2 ACCEPTABLE MANUFACTURERS

A. The design is based upon sheet metal flashing and trim systems engineered and manufactured by or approved equal:

1. Provide edge metal components manufactured by roofing system manufacturer.

2.3 MATERIALS

A. General: Product designations for the materials used in this section shall be based on performance characteristics of the R-MER Edge Coping and R-Mer Force Fascia Systems manufactured by the Garland Company, Cleveland, OH, and shall form the basis of the contract documents. Substitutions will be approved in accordance with Specification Section 01300.

B. Materials:

1. Exposed base metal material:

a. Exposed base metal material for copings, fascia, and trim components related to signed and soffits: Aluminum, ASTM B209, alloy 3105-H14, in thickness of .050" nom.

2. Unexposed base metal material:

a. Flash-less Snap-On Fascia Extruded Base Anchor and Anchor Splice Plates: 6005A-T61 extruded aluminum

3. Components for Flashless metal edge system

a. Compression Seal for top of anchor: TPE thermoplastic elastomer.

b. Sealant for Flange: Single-component high performance 100% solids, interior and exterior polyether joint sealant

4. Aluminum sheet for Exposed Applications including miscellaneous trim between windows/curtainwall units: ASTM B209; 6063-T2 alloy,

minimum 0.050 inch thick; fluoropolymer Kynar 500 finish; color as selected by Architect.

5. Aluminum Sheet for Concealed Applications: ASTM B209; 6063-T2 alloy, minimum .032 inch thick; mil finish.

6. Minimum gauge of aluminum to be specified in accordance with Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc. recommendations.

C. Coping

1. Cover and Splice Plate: Concealed 6 inch splice plates.

2. Anchor Chair: 16 gauge G-90 galvanized steel.

3. ANSI/SPRI ES-1 approved.

4. FM certified assemblies.

D. Finishes:

1. Exposed surfaces for coated panels:

a. Steel Finishes: fluorocarbon finish. Epoxy primer baked both sides, .2-.25 mils thickness as approved by finish coat manufacturer. Weathering finish as referred by National Coil Coaters Association (NCCA).

Property	Test Method	Fluorocarbon*	
Pencil Hardness	ASTM D-3363 NCAA II-2	HB-H	
Bend	ASTM D-4145	O-T	NCAA II-19
Cross-Hatch Adhesion	ASTM D-3359	no loss of adhesion	
Gloss (60° angle)	ASTM D-523	25+/-5%	
Reverse Impact	ASTM D-2794	no cracking or loss of adhesion	
Nominal Thickness primer 0.2 mils topcoat 0.8 mils TOTAL 1.0 mils	ASTM D-1005		

*Subject to minimum quantity requirements

b. Include optional Aluminum Anodized finish for all exposed metal to match existing finishes.

c. Finish color to be selected by Owner from Manufacturer's full range of standard and premium color options.

2. Exposed and unexposed surfaces for mill finish flashing, fascia, and coping cap, shall be as shipped from the mill.

2.4 RELATED MATERIALS AND ACCESSORIES

A. Metal Primer: Zinc chromate type.

B. Plastic Cement: ASTM D 4586

C. Sealant: Specified in Section 07920 or on drawings.

D. Underlayment: ASTM D2178, No15 asphalt saturated roofing felt.

E. Fasteners:

1. Corrosion resistant screw fastener as recommended by metal manufacturer. Finish exposed fasteners same as flashing metal.

2. Fastening shall conform to Factory Mutual 1-90 requirements or as stated on section details, whichever is more stringent.

PART 3 - EXECUTION

3.1 EXECUTION, GENERAL

A. Refer to Division 07 Section Common Work Results for Thermal and Moisture Protection.

3.2 PROTECTION

A. Isolate metal products from dissimilar metals, masonry or concrete with bituminous paint, tape, or slip sheet. Use gasketed fasteners where required to prevent corrosive reactions.

3.3 GENERAL

A. Secure fascia to wood nailers at the bottom edge with a continuous cleat.

B. Fastening of metal to walls and wood blocking shall comply with SMACNA Architectural Sheet Metal Manual, and manufacturer's recommendations whichever is the most stringent standard.

C. All accessories or other items essential to the completeness of sheet metal installation, whether specifically indicated or not, shall be provided and of the same material as item to which applied.

D. Allow sufficient clearances for expansion and contraction of linear metal components.

E. Secure metal using fasteners as required by the system. Exposed face fastening will be rejected.

3.4 INSPECTION

A. Verify that curbs are solidly set and nailing strips located.

A. Perform field measurements prior to fabrication.

B. Coordinate work with work of other trades.

C. Verify that substrate is dry, clean and free of foreign matter.

D. Commencement of installation shall be considered acceptance of existing conditions.

3.5 MANUFACTURED SHEET METAL SYSTEMS

A. Furnish and install manufactured fascia, fascia extender and coping cap systems in strict accordance with manufacturer's printed instructions.

B. Provide factory-fabricated accessories including, but not limited to, fascia extenders, miters, scuppers, joint covers, etc. Refer to Source limitation provision in Part 1.

3.6 SHOP-FABRICATED SHEET METAL (ACCESSORY TRIM)

A. Metal work shall be shop fabricated to configurations and forms in accordance with recognized sheet metal practices. Fabricate scuppers as shown of drawing

B. Hem exposed edges.

C. Angle bottom edges of exposed vertical surfaces to form drip.

D. Lap corners with adjoining pieces fastened and set in sealant.

E. Install sheet metal to comply with refernced SMACNA and NRCA standards.

3.7 FLASHING MEMBRANE INSTALLATION

A. Flash-less Snap-On Fascia Detail with Extruded Aluminum Base Anchor

1. Position base ply of the Modified Roofing membrane over the roof edge covering nailers completely, fastening eight (8) inches on center. Install membrane and cap sheet with proper material and procedure according to manufacturer’s recommendations. Cap sheet shall stop at the edge of the roof and shall not turn over the edge of the nailer.

2. Prior to installing the base anchor, assure a level plane is present. If not, shim the roof edge surface as required.

3. Extruded base anchor: Apply two 1/4" beads of Green-Lock Sealant XL or equal on the bottom surface of the top flange of the extruded anchor.

4. Set the extruded anchor on the edge and face fasten through pre-punched slots every 18 inches o.c. for 5.75 inch face fascia, and 18 inches o.c. staggered for any fascia size greater than 5.75 inches. Begin fastening 6 inches from ends.

5. Install Green-Lock Sealant XL or equal at the ends of the base frame to prevent water from running between base anchor joints.

6. Install compression seals every 40 inches on center in the slots located at the top of the extruded anchor.

7. Install fascia cover setting the top flange over the top flange and compression seals of the base anchor. Assure compression seals are in place during this process. Beginning on one end and working towards the opposite end, press downward firmly (do not rotate) until “snap” occurs and cover is engaged along entire length of miter.

8. Install splice plate at each end of the base anchor and fascia cover prior to the installation of the next adjacent ten foot piece.

B. Slip Flashing / Counterflashing Detail

1. Install new slip flashing under existing metal and terminate with fasteners 8” on center incorporating neoprene washers.

2. All slip flashing shall be fabricated to mirror the substrate to which they are attached and include a hemmed drip edge.

3. Install new stainless steel counterflashing manufactured for use in the existing reglet and snap into place

C. Pitch Pocket

1. All pitch pockets are to be fabricated a minimum of 4” high and shall be fabricated from 16 oz. copper, lead coated copper or stainless. All pitch pockets shall have closed corners and be soldered. Field soldering is required for the fourth corner.

D. Coping Detail

1. Install miters first.

2. Position base flashing of the Built-Up and/or Modified Roofing membrane over the wall edge covering nailers completely, fastening eight (8) inches on center. Install membrane and cap sheet with proper material and procedure according to manufacturers’s recommendations.

3. Install minimum twelve (12) inch wide anchor chair at 30” on center.

4. Install 8” wide splice plate by centering over 12” wide anchor chair. Apply two beads of sealant to either side of the splice plate’s center. Approximately 2” in from the coping cap joint. Install Coping Cap by hooking outside hem of coping on outside face of anchor chair. Press downward on inside edge of coping until “snap” occurs and hem is engaged on the entire chair.

3.8 CLEANING

A. Clean installed work in accordance with the manufacturer's instructions.

B. Replace damaged work than cannot be restored by normal cleaning methods.

3.9 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated. Comply with requirements of authorities having jurisdiction

3.10 FINAL INSPECTION

A. At completion of installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Inspect work and flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Notify the Architect upon completion of corrections.

E. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

F. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty-four (24) hours, the Owner will exercise rights to correct the Work under the terms of the Conditions of the Contract.

3.11 DEMONSTRATION AND TRAINING

A. At a time and date agreed to by the Owner, instruct the Owner's facility manager, or other representative designated by the Owner, on the following procedures:
   1. Troubleshooting procedures.
   2. Notification procedures for reporting leaks or other apparent roofing problems.
   3. Maintenance.
   4. The Owner's obligations for maintaining the warranty in effect and force.
   5. The Manufacturer's obligations for maintaining the warranty in effect and force.

END OF SECTION

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. Downspouts.
2. Gutters.
3. Accessories.

B. Related Sections:

1. Division 07 Section "Metal Roof Panels".

1.3 REFERENCES

A. SMACNA – Architectural Sheet Metal Manual

B. ASTM 13209 - Aluminum and Aluminum Alloy Sheet and Plate.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Submit two (2) samples 4 x 6 inch in size illustrating metal finish color.

1.5 QUALITY ASSURANCE

A. Fabricator and Installer: Company specializing in sheet metal flashing work with 3 years documented experience.

B. Perform work in accordance with SMACNA standard details and requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials which may cause discoloration or staining.

1.7 COORDINATION

Coordinate the work with downspout discharge into downspout boot and site drainage piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Gutters & Downspouts; Englert, Inc., Perth Amboy, NJ (908) 826-8614.

B. Acceptable Manufacturer: Nitterhouse Masonry Products, LLC, 859 Cleveland Ave., Chambersburg, PA 17201 (717) 267-4500.

C. Or approved equal.

2.2 MATERIALS

A. Aluminum Sheet (Gutter & Downspouts): ASTM B209, aluminum alloy, smooth, Kynar 500; color as selected by Architect. (See schedule for thickness).

2.3 ACCESSORIES

A. Fasteners: Manufacturer's standard type to suit application, stainless steel; any exposed fastener caps to be same color as adjacent material.

B. Gutter Anchors: Concealed Heavy-Duty, 6-inch Quick Screw hidden hanger with clip, or equal.

C. Downspout Anchorage Devices: Use Racks, Keys, and Drives to secure downspouts to the wall. Size and spacing as recommended by fabricator.

D. Sealant: Manufacturer's standard type suitable for use with installation of system; non-staining; non-skinning.

E. Protective Backing Paint: Bituminous.

2.4 COMPONENTS

A. Gutters: 5” box gutters; fabricate gutters of dimensions required with closure flange trim to exterior.

B. Downspouts: 3" x 4" Rectangular style unless noted otherwise. Furnish with metal hangers, from the same material as downspouts and anchors.

2.5 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate scupper boxes of stainless-steel sheet metal, interlockable with sheet.

C. Form pieces in longest possible lengths.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

G. Form flashings to protect roofing materials from physical damage and shed water.

H. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

2.6 FINISH

A. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

B. Paint downspout boots. See Section 099000 - Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conform to drawing details included in the SMACNA manual.

B. Seal metal joints watertight.

C. Secure gutters and downspouts in place using concealed fasteners.

D. Weather lap joints minimum 2 inches and seal weathertight with plastic cement.

E. Pipe underground into site drainage system as indicated on Drawings.

3.2 SCHEDULE

Location	Material	Style	Thickness	Size	Finish
Gutters	Pre-coated Aluminum	Box	.040	5”	Kynar 500 Aluminum
Downspouts	Pre-coated Aluminum	Rectangular	.040	3” x 4”	Kynar 500 Aluminum

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Interior and exterior joint sealants.

B. Principal Products:

1. Sealants.
2. Preformed joint seals.
3. Backer rod and accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate work of this section with completion of substrates.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting minimum one week before starting Work of this Section for exterior building sealants.
2. Additional Attendees: All installers of exterior joint sealants.

1.3 ACTION SUBMITTALS

A. Submittal Procedures:

1. Provide submittals for all sealants, exterior and interior, in a single group, regardless of how many subcontractors will install sealants. Multiple submittals for sealants are not acceptable.

B. Product Data:

1. Each sealant type.
2. Expanding tape seals.
3. Initial selection color charts and samples.

C. Samples:

1. Cured sealant custom color ribbons; 12 inches minimum length.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Provide written verification and list of products for work under subsequent work packages that the same proprietary sealants will be used that were used for previous work packages.

B. Test and Evaluation Reports: Manufacturer test results showing:

1. Compatibility between sealant and substrate.
2. Priming requirements for each substrate and sealant.
3. Staining potential.

C. Field Quality Control Submittals: Field test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data.

B. Warranty Documentation: Sealants.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agencies: Acceptable to authorities having jurisdiction.

B. Source Control: Provide only one brand of sealant for each required type, regardless of number of applicators.

C. Preconstruction Testing: Complete testing minimum 30 days before scheduled field installation.

1. Adhesion: Test exterior wall sealants for adhesion to metal and masonry per ASTM C794 to determine need for primer and substrate preparation.
2. Staining: Test exterior wall sealants for staining of masonry per ASTM C1248.

D. Mockups: Install sealants in exterior wall mockups. Demonstrate product interfaces, intersections, and terminations.

1. Adhesion: Test sealant joints in mockup per ASTM C1193, Method A in Appendix X1.1 or ASTM C1521, Method A. At joints between different materials, test each joint surface separately.
2. Approved mock-ups establish work results standard.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform work within the following limitations.

1. Temperature: Perform work within sealant manufacturer temperature limits, but not below 40 deg F.
2. Precipitation: None occurring and none predicted within 12.

1.8 WARRANTY

A. Manufacturer Warranty:

1. Exterior Sealants: Warrant against product failure.

a. Failure includes loss of elastomeric properties and required performance attributes, and discoloration of substrates.
b. Warranty Period - Urethanes: Five years.
c. Warranty Period - Silicones: 20 years.

PART 2 - PRODUCTS

2.1 SEALANTS - GENERAL

A. Source Control: Provide one proprietary product for each type of sealant required, regardless of what subcontractor installs the sealant.

1. Installers of joint sealants under subsequent work packages must use the same proprietary sealants used in the first work package that includes joint sealants.

B. Select proprietary sealants for compatibility with other construction products that the sealants will contact.

C. Multiple colors may be required for exposed sealants to coordinate with substrate colors.

2.2 EXTERIOR EXPOSED NONTRAFFIC SEALANTS

A. Medium Modulus Silicone Sealant: Single-component, nonsag, neutral-curing; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 795.
b. GE Construction Sealants SCS2000 SilPruf.
c. Pecora Corporation PCS.
d. Sika Corporation Sikasil WS-295.
e. Tremco Spectrem 2.
f. Or approved equal.

2. Colors: Architect selected.

B. Medium Modulus Silicone Nonstaining Sealant: Single-component, nonsag, neutral-curing; ASTM C920, Type S, Grade NS, Class 50, Use NT; classed as nonstaining when tested per ASTM C1248.

1. Manufacturers and Products:

a. Dow DOWSIL 756 SMS.
b. GE Construction Sealants SCS9000 SilPruf NB.
c. Pecora Corporation 864NST.
d. Tremco Spectrem 3.

e. Or approved equal.

2. Colors: Architect selected.

2.3 EXTERIOR PEDESTRIAN AND GARAGE TRAFFIC SEALANTS

A. Pourable Urethane Sealant: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Manufacturers and Products:

a. Master Builders Solutions MasterSeal SL1.
b. Sika Corporation Sikaflex 1c SL.
c. Or approved equal.

2. Colors: Architect selected.

2.4 EXTERIOR CONCEALED SEALANTS

A. Silicone Air Barrier Sealant: Single-component, nonsag, neutral curing; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 758 Silicone Weather Barrier Sealant.
b. Pecora Corporation AVB.
c. Or approved equal.

2. Applications:

a. Primary weatherproofing exterior joints between air- and water-resistive membranes and fenestration, doors, and louvers.

2.5 EXTERIOR PREFORMED JOINT SEALS

A. Silicone Extrusion Seals: Cured low-modulus silicone extrusion transition membrane and liquid-applied sealant for exterior wall openings.

1. Manufacturers and Products:

a. Dow DOWSIL Silicone Transition System with DOWSIL 758 silicone adhesive.
b. Pecora Corporation Sil-Span with 864NST silicone adhesive.
c. Sika Silbridge-300 with Sikasil WS-295.
d. Tremco Proglaze ETA with Spectrem 1 Silicone Sealant.
e. Or approved equal.

2. Joint Widths: See Drawings.
3. Applications:

a. Transitions between air- and water-resistive membrane and fenestration, doors, and louvers.

2.6 INTERIOR SEALANTS AND CAULKING

A. Interior Color Sealant: Silane-modified polymer sealant or urethane; ASTM C920, S, Grade NS, Class 50, Uses T and NT.

1. Manufacturers and Products:

a. Master Builders Solutions MasterSeal NP2.
b. Pecora Corporation DynaTrol DynaTrol I XL FTH.
c. Sika Corporation Sikaflex 2c NS EZ Mix.
d. Tremco Dymeric 240FC.
e. Or approved equal.

2. Colors: Architect selected.
3. Applications:

a. Interior joints noted as‘sealant’ on Drawings.
b. Control and expansion joints in tile, except where sanitary sealant is shown.
c. Terminations of wall coverings at tile and other materials.
d. Sealant joints in ornamental metals.

B. Sanitary Sealant: Mildew-resistant silicone; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 786 SILICONE SEALANT
b. Pecora Corporation; 860.
c. Tremco Incorporated; Tremsil 200 Sanitary.
d. Or approved equal.

2. Colors: Architect selected.
3. Applications:

a. Joints around plumbing fixtures and fittings.
b. Joints between showers and tile.
c. Perimeters of lavatory counters.
d. Control and expansion joints in food preparation areas.

C. Paintable Caulking: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers and Products:

a. Master Builders Solutions MasterSeal NP 520.
b. Pecora Corporation AC20.
c. Tremco Tremflex 834.
d. Or approved equal.

2. Applications:

a. Interior joints noted as 'caulking.'
b. Joints, crevices, and irregularities wider than hairline joints in or between painted surfaces.
c. Perimeters of door frames, frames and trim for glazing, and frames or trim for other wall and ceiling openings at painted surfaces.
d. Ceiling joints between structural precast concrete floor planks.

2.7 INSTALLATION ACCESSORIES

A. Primer: As required by sealant manufacturer.

B. Backer Rod: ASTM C1330, Type C, closed-cell or Type O, open-cell, as recommended by sealant manufacturer.

C. Bond Breaker Tape: Self-adhesive plastic tape to prevent sealant from adhering to back of joint.

D. Cleaners: As recommended by sealant manufacturer.

E. Masking: Non-staining, self-adhesive.

2.8 MIXES

A. Multicomponent Sealants: Mix tinting colorant with base sealant to uniform consistency and custom color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean joint surfaces for optimum adhesion. Remove dirt, moisture, and incompatible substances.

B. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

C. Remove laitance and form release agents from concrete.

D. Existing Joints: Cut out and remove existing joint sealants down to original substrate. Small amounts of elastomeric sealants left in surface irregularities of concrete and masonry may be left in place subject to Architect’s approval, provided that they are securely bonded to surface, are compatible with new sealant, and are tested to demonstrate that suitable adhesion with new sealant can be achieved. Where these conditions cannot be met, remove existing sealants completely.

E. Prime joint surfaces where recommended by sealant manufacturer. Protect adjacent surfaces from misapplication or spillage of primer.

F. Mask surfaces adjacent to joints to receive elastomeric sealants. Remove masking after tooling.

3.2 INSTALLATION

A. Installation Reference Standard: Follow ASTM C1193.

B. General Installation Requirements:

1. Exterior Joint Sealants: Provide continuous, weatherproof seals to prevent infiltration of air and water through the joints.

2. Interior Joint Sealants: Provide continuous seals to prevent air and smoke infiltration through the joints in which they are installed. Install sanitary sealant to prevent water infiltration.
3. Appearance: Apply sealants with smooth surfaces free of gaps, voids, bubbles, lumps, crevices, runs, drips, striations, and other irregularities.

C. Set joint filler units at uniform depths in joints to support sealants and maintain proper sealant cross-section shape and depth within the following general limitations, measured at center (thin) section of beads.

1. Pavement Joints: Sealant depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
2. Other Joints: Sealant depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.

D. Set joint filler for sealant neck dimension of maximum 1/3 of joint width.

E. Install joint fillers under compression and friction fit. Do not install filler units that have absorbed water.

1. Do not leave voids or gaps between ends of joint filler units.
2. Do not stretch, twist, puncture, or tear joint fillers.
3. Remove joint fillers that have absorbed moisture or which have ruptured gas cells and install suitable new fillers before sealant application.

F. Install bond breaker tape where required or where joint filler is not used to prevent adhesion to back of joint.

G. Deposit sealants in uniform, continuous ribbons without gaps and air pockets.

H. Tool sealants to ensure full adhesion. Form smooth, slightly concave surface.

I. Cure joint sealants.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Retesting of Failed Tests: Performed at Contractor's expense.
2. Do not use materials that fail tests and inspections.

B. Adhesion Testing: ASTM C1193, Method A in Appendix XI.

1. Perform 10 tests.
2. Report Content:

a. Presence of voids and discontinuities.
b. Sealant dimensions and seal shape.
c. Failures in adhesion and cohesion.

C. Non-Conforming Work: Remove sealants that do not pass tests, reapply sealant, and retest. Retesting of failed work shall be at Contractor’s expense.

3.4 CLEANING

A. Clean spills, misapplications, and material migrations immediately as they occur.

B. Clean marred surfaces by whatever means are necessary to eliminate evidence of spillage.

END OF SECTION

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 references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives.

The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should

be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. YA - ASSA ABLOY ACCENTRA
5. MC - Medeco
6. RF - Rixson

Hardware Sets

Set: 1.0

Doors: 01-1

2	Continuous Hinge	CFM_SLF-HD1-M x Length Required		PE
1	Mullion	KRM200SM x Length Required	600	YA
1	Rim Exit Device, Nightlatch	6105ED 121NL Temp Core	630	YA
1	Rim Exit Device, Exit Only	6105ED EO Temp Core	630	YA
4	Permanent Core	Per keying conference	26	MC
2	Surface Closer	UNI/UNIJ4400 (As Required)	600 x 689	YA
2	Sweep	3452CNB x Length Required		PE
1	Threshold	273x224AFGT x Length Required		PE

Notes: Perimeter and meeting stile gasket by door / frame manufacturer.

Set: 2.0

Doors: 05-1

3	Hinge, Full Mortise, Hvy Wt	T4A3386 [NRP] FT	US32D	MK
1	Storeroom Lock	AU 4705LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Surface Closer	UNI4400	600 x 689	YA
1	Gasketing	303AS		PE
1	Rain Guard	346C (Omit at overhangs)		PE
1	Sweep	3452CNB x Length Required		PE
1	Threshold	273x224AFGT x Length Required		PE

Set: 3.0

Doors: 13-1

3	Hinge, Full Mortise, Hvy Wt	T4A3386 [NRP] FT	US32D	MK
1	Classroom Lock	AU 5408LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Surface Closer	UNI4400	600 x 689	YA
1	Gasketing	303AS		PE
1	Rain Guard	346C (Omit at overhangs)		PE
1	Sweep	3452CNB x Length Required		PE
1	Threshold	273x224AFGT x Length Required		PE

Set: 4.0

Doors: 04-2, 15-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Storeroom Lock	AU 4705LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Surface Closer	3501	689	YA
1	Door Stop	409/441CU (As Required)	US26D	RO
3	Silencer	608		RO

Set: 5.0

Doors: 12-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Storeroom Lock	AU 4705LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Surface Closer	3531	689	YA
1	Gasketing	S88C		PE

Set: 6.0

Doors: 14-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Entry Lock	AU 4704LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Door Stop	409/441CU (As Required)	US26D	RO
3	Silencer	608		RO
1	Coat Hook	802	US26D	RO

Set: 7.0

Doors: 04-1, 13-2

6	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555 / 557 (12"/72" AFF)	US26D	RO
1	Classroom Lock	AU 5408LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
2	Door Stop	409/441CU (As Required)	US26D	RO
2	Silencer	608		RO

Set: 8.0

Doors: 03-1, 11-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Classroom Lock	AU 5408LN Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Door Stop	409/441CU (As Required)	US26D	RO
3	Silencer	608		RO

Set: 9.0

Doors: 10-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Deadbolt	D161 Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Push Plate	70C-RKW	US32D	RO
1	Straight Pull	RM322 (Mtg-Type as required)	US32D	RO
1	Surface Closer	3531	689	YA
3	Silencer	608		RO

Set: 10.0

Doors: 07-1, 08-1

3	Hinge, Full Mortise	TA2714 [NRP] FT	US26D	MK
1	Deadbolt	D161 Temp Core	626	YA
1	Permanent Core	Per keying conference	26	MC
1	Push Plate	70C-RKW	US32D	RO
1	Straight Pull	RM322 (Mtg-Type as required)	US32D	RO
1	Surface Closer	3501	689	YA
1	Door Stop	409/441CU (As Required)	US26D	RO
1	Gasketing	S88C		PE

END OF SECTION 080671

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 and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
4. Division 08 Section "Door Hardware".
5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies 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 according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.4 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 non-vented plastic.

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. Door and frames to be stacked in a vertical upright position.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 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.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

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.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch 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 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.

4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. CECO Door Products (C) Polystyrene Core - Legion Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. CECO Door Products (C) - SU SR Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. CECO Door Products (C) - DU Series.
b. CECO Door Products (C) - SU Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or

perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 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. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: 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.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Knocked Down Frames: Provide frames with locking corner tabs which permit field assembly. Factory install compression type anchors and countersunk screw holes to secure the bottom of the jambs.
4. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
5. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
6. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

7. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
8. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
9. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
10. 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 on-center 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.

    b. Stud Wall 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) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
11. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
12. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template 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/SDI A250.8.
2. Reinforce doors and frames to receive non-template, 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.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

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; and compatible with substrate and field-applied coatings.

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. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. 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 square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

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 ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

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.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

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 and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

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. Flush wood doors, rated and non-rated.

B. Related Sections:
1. Division 06 Section – Carpentry Work.
2. Division 08 Section – Standard Steel Frames.
3. Division 08 Section – Door Hardware.

1.3 REFERENCES

A. ANSI/HPMA HP - Hardwood and Decorative Plywood.

B. ASTM E413 - Classification for Determination of Sound Transmission Class.

C. AWI - Quality Standards of the Architectural Woodwork Institute.

D. NFPA 80 - Fire doors and windows.

E. UL 10B Fire tests of door accessories.

F. Warnock Hersey - Certification listings for fire doors.

1.4 SUBMITTALS

A. Submit under provisions of Division 1 - General Requirements.

B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, identify cutouts for hardware, glazing, etc.

C. Product Data: Indicate door core materials and construction; veneer species, type and characteristics; and factory machining criteria.

D. Samples: Submit two samples of door veneer, 4 x 4 inch in size illustrating wood grain, stain color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with AWI Quality Standard Section 1300, Premium Grade.

B. Finish doors in accordance with AWI Quality Standard Section 1500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 1 - General Requirements.

B. Package, deliver, and store doors in accordance with AWI Section 1300.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on-site to permit ventilation.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

A. Coordinate work under provisions of Division 1 - General Requirements.

B. Coordinate the work with door opening construction, door frame and door hardware installation.

1.10 WARRANTY

A. Provide warranty under provisions of Division 1 - General Requirements.

B. Include lifetime warranty coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers providing the products supplied comply with this specification:
   1. VT Industries (Basis of Design).
   2. Pioneer Industries
   3. Or approved equal.

2.2 DOOR TYPES

A. Flush Interior Doors: 1-3/4" thick; solid core and hollow core construction; rated and non-rated.

B. Flush Interior Doors with Glazing: 1-3/4” thick; solid core construction with factory cut openings as per Drawings, rated and non-rated.

2.3 DOOR CONSTRUCTION

A. Solid non-rated and fire rated core: AWI Section 1300.
   1. Non-Rated: SRC-Stile and rail, particle core bonded to stiles and rails.
   2. Rated: Stile and rail, mineral core; label as per schedule.

2.4 DOOR FACING

A. Veneer Facing: AWI Custom quality premium white birch, rotary sliced; pre-finished to match existing.
   1. Basis of design is “Ravine” by VT Industries.

2.5 ADHESIVE

A. Facing Adhesive: Type II - water resistant.

2.6 FABRICATION

A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.

B. Fabricate fire rated doors in accordance with AWI Quality Standards and to UL requirements. Attach fire rating label to door.

C. Provide lock blocks at lock edge and top of door for closer and hardware reinforcement.

D. Vertical Exposed Edge of Stiles: Of same species as veneer facing. Hardwood for transparent finish facing.

E. Fit door edge trim to edge of stiles after applying veneer facing.

F. Bond edge banding to cores.

G. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that opening sizes and tolerances are acceptable.

B. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install doors in accordance with AWI Quality Standards.

B. Trim door width by cutting equally on both jamb edges.

C. Trim door height by cutting bottom edges to a maximum of 3/4 inch.

D. Pilot drill screw and bolt holes.

E. Machine cut for hardware. Core for handsets and cylinders.

F. Coordinate installation of doors with installation of frames.

3.3 TOLERANCES

A. Conform to AWI requirements for fit and clearance tolerances.

B. Conform to AWI Section 1300 requirements for maximum diagonal distortion.

3.4 ADJUSTING

A. Adjust work under provisions of Division 1 - General Requirements.

B. Adjust door for smooth and balanced door movement.

3.5 3.5 SCHEDULE

A. See Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Storefront frames.
2. Perimeter sealant.

B. Related Sections
1. Division 07 Section - Joint Sealers
2. Division 08 Section - Glazing

1.2 REFERENCES

A. AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. AAMA - Curtain Wall Manual #10 - Care and Handling of Architectural Aluminum from Shop to Site.

C. AAMA 606.1 - Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.

D. AAMA 605.2-92 - Specifications for High Performance Organic Coatings on Architectural Extrusions and Panels.

E. AAMA SFM-1 - Aluminum Storefront and Entrance Manual.

F. ANSI A117.1 - Safety Standards for the Handicapped.

G. ANSI/ASTM E283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.

H. ANSI/ASTM E330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

I. ANSI/ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

1.3 SYSTEM DESCRIPTION

A. Aluminum entrance and storefront system includes tubular aluminum sections, doors, shop fabricated, factory pre-finished, related flashings, anchorage and attachment devices.

1.4 PERFORMANCE REQUIREMENTS

A. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as measured in accordance with ANSI/ASTM E330.

B. Limit mullion deflection to flexure limit of glass L/175; with full recovery of glazing materials.

C. System to accommodate, without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

D. Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with AAMA 501 and ANSI/ASTM E283.

E. Water Leakage: None, when measured in accordance with AAMA 501 with a test pressure difference of 15 lbf/sq ft.

F. Maintain continuous air and vapor barrier throughout assembly, primarily in line with pane of glass and heel bead of glazing compound.

G. System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F over a 12-hour period without causing detrimental effect to system components.

H. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.5 SUBMITTALS

A. Submit under provisions of Division 1 - General Requirements.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work and expansion and contraction joint location and details.

C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass door hardware, and internal drainage details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with AAMA SFM-1 and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Conform to requirements of ANSI A117.1.

1.7 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 - General Requirements.

B. Handle work of this section in accordance with AAMA - Curtain Wall Manual #10.

C. Protect pre-finished aluminum surfaces with wrapping or stripable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealants when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.11 COORDINATION

A. Coordinate Work under provisions of Division 1 - General Requirements.

1.12 WARRANTY

A. Provide three-year warranty under provisions of Division 1 - General Requirements.

B. Warranty: Include coverage for complete system for failure to meet specified requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. YKK YES 45 TU Thermally Broken Center Set Commercial Storefront System: Series 35D Medium Stile Doors. Exterior locations.

B. Or approved equal.

C. Accessories: As specified.

D. Substitutions: Under provisions of Division 1 - General Requirements.

2.2 MATERIALS

A. Extruded Aluminum: ANSI/ASTM B221.

B. Sheet Aluminum: ANSI/ASTM B209.

C. Fasteners: Stainless steel.

2.3 COMPONENTS (DOORS & FRAME) – EXTERIOR

A. Frame: 2" x 4 1/2" nominal; thermally broken; flush glazing stops; internal weep drainage system.

B. Intermediate mullion: 2"x 4 1/2" nominal, thermally broken, flush glazing stops.

C. High Performance Sill Flashing: Compatible with system.

D. Base: sidelight base; non-thermally broken, 2" x 4 1/2" nominal.

E. Doors: 1-3/4 inches thick, 2 1/2 inch wide top rail, 4 1/2 inch wide vertical stiles, 10 inch ADA base bottom rail; beveled glazing stops.

F. Flashings: .040 inch minimum, aluminum, finish to match mullion sections where exposed.

G. Storefront and Door Finish: Fluropon Architectural Coating; color: Black.

H. Heavy Wall Mullion: 2" x 4 1/2" nominal; thermally broken; locations as required by system manufacturer.

I. Thermal Flat Filler: Compatible with system.

J. Strap Anchor: Compatible with system.

2.4 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: As specified in Section 088000 or as described above.

B. SEALANT MATERIALS

C. Sealant and Backing Materials: As specified in Section 079000.

2.5 HARDWARE

A. See Hardware Schedule - Section 087100 for all door hardware sets or as described above.

2.6 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to conceal from view.

E. Prepare components with internal reinforcement for door hardware.

F. Reinforce framing members as required for imposed loads.

2.7 FINISHES

A. Finish coatings: Conform to AAMA 2605-02, Fluropon Architectural Coating; 70% fluoropolymer (Hylar 5000 or Kynar 500); color: Black.

B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft.

C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site opening conditions under provisions of Division 1 - General Requirements.

B. Verify dimensions, tolerances, and method of attachment with other work.

C. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and AAMA - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to provide permanent fastening to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

F. Install required flashings.

G. Set thresholds in bed of mastic and secure.

H. Install hardware using templates provided. Refer to Section 087120 for installation requirements.

I. Install glass in accordance with Section 088000, to glazing method required to achieve performance criteria.

J. Install perimeter sealant to method required to achieve performance criteria.

K. Install frameless interior doors in accordance with manufacturer’s instructions.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.

B. Maximum Misalignment of two adjoining members abutting in plane: 1/32 inch.

3.4 ADJUSTING

A. Adjust work under provisions of Division 1 - General Requirements.

B. Adjust operating hardware for smooth operation.

3.5 CLEANING

A. Clean work under provisions of Division 1 - General Requirements.

B. Remove protective material from pre-finished aluminum surfaces.

C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

D. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of Division 1 - General Requirements.

B. Protect finished work from damage.

END OF SECTION

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-clad wood-framed windows of the following types: Awning and Picture.

B. Related Sections:
1. Division 06 - Carpentry Work.
2. Division 07 - Composite Wall Panels

1.3 REFERENCES

A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

B. American Architectural Manufacturers Association (AAMA):
1. AAMA 450 - Voluntary Performance Rating Method for Mulled Fenestration Assemblies.
2. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
3. AAMA 613 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.
4. AAMA 614 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Plastic Profiles.
5. AAMA 623 - Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.
6. AAMA 624 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Fiber Reinforced Thermoset Profiles.
7. AAMA 902 - Voluntary Specification for Sash Balances.
8. NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights.

C. Andersen Corporation: Andersen 400 Series Installation Guide.

D. ASTM International (ASTM):
1. ASTM C1036 - Standard Specification for Flat Glass.
2. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
3. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

4. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
5. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
6. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
7. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
8. ASTM F2090 - Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance Requirements:
   1. Comply with requirements of NAFS.

B. Windborne Debris Performance Requirements:
   1. Florida Building Code Test Protocol: TAS 201, TAS 202 and TAS 203.
   2. ASTM E1886 and ASTM E1996.

1.5 SUBMITTALS

A. Product Data: For each type of product required.

B. Shop Drawings: Showing methods of installation, plans, sections, elevations and details of walls, specified loads, flashings, vents, sealants, and interfaces with all materials not supplied by the window manufacturer, and identification of proposed component parts and finishes.

C. Samples: Selection and verification samples for finishes, colors and textures. Submit two complete sample sets of each type of material required.

D. Certificates: Signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.

E. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

F. Manufacturer Instructions: Manufacturer installation, storage, and other instructions.

G. Qualification Statements: For manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Member in good standing of the Insulating Glass Certification Council (IGCC).
   2. Hallmark Certified Manufacturer and member in good standing of the Window and Door Manufacturers Association (WDMA).
   3. Member in good standing of U.S. Green Building Council.
   4. U.S. ENERGY STAR Partner.

5. Capable of demonstrating an extended history of window and door design, production and innovation.

B. B. Installer Qualifications:
1. Minimum five years experience in the commercial installation of products required for the Project.
2. Experience on at least five projects of similar size, type and complexity as the Project.
3. An entity utilizing workers competent in techniques required by manufacturer for product types and applications indicated

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

B. Deliver materials to Project in manufacturer’s original unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials and accessories protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer off ground, under cover and not exposed to weather and construction activities.

1.8 WARRANTY

A. Special Warranty: Manufacturer's transferrable, non-prorated limited warranty.
1. Warranty Period, Glass: 20 years.
2. Warranty Period, Non-Glass Parts: 10 years.

PART 2 - PRODUCTS

2.1 WOOD WINDOWS

A. General: Provide windows complying with the performance requirements indicated and tested according to NAFS.

B. Basis-of-Design Product: Subject to compliance with requirements provide Andersen Corporation; Andersen 400 Series windows.

C. Substitutions: Equal products are permitted subject to approval.

2.2 MATERIALS

A. Construction:
1. Frame: Finger-jointed or laminated veneer lumber capped with rigid vinyl, preservative treated WDMA I.S. 4.
2. Interior Sash: Solid lumber, kiln dried and suitable for stain or painted finish, preservative treated WDMA I.S. 4.
3. Exterior Sash: Co-extruded rigid vinyl or liquid-applied vinyl over finger-jointed lumber.

B. Wood Species: Clear pine

C. Interior Finish:
   1. Custom: Site-finished. Painted.

D. Exterior Finish:
   1. Frame and Sash: AAMA 613, AAMA 614 for color retention.
      a. Color: Black
   2. Trim: AAMA 623, AAMA 624 for color retention
      a. Color: Black

2.3 WINDOWS

A. Window Type: Awning and Picture as indicated on Drawings.

B. Performance Grade Requirements:
   1. Awning Performance Class LC and Grade, Non-Impact-Resistant: PG70.
   2. Awning Performance Class LC and Grade, Impact-Resistant: PG70
   3. Awning Picture Performance Class LC and Grade, Non-Impact-Resistant: PG70.
   4. Awning Picture Performance Class LC and Grade, Impact-Resistant: PG70.

C. Air Infiltration Requirements:
   1. Air Infiltration Rate: < 0.2 cfm/sf².

D. Environmental Certifications:
   1. ENERGY STAR performance requirements.
   2. Indoor air quality performance.

E. Weatherstrip:
   1. Type and Material for Awning: Flexible vinyl bulb or vinyl covered foam gasket.

F. Attachment Flange:
   1. Type and Material for Awning: Integral rigid vinyl.

G. Hardware:
   1. Operator Gear Type and Material: Rotary, die-cast zinc and stainless steel components.
   2. Hinge Type and Material: Concealed hinge and track, standard, 400 series galvanized steel.
   3. Crank Handle Material and Style: Die-cast zinc Classic Series.
   4. Sash Lock Type and Material: Single actuation, die-cast zinc and engineered polymer components.
   5. Crank and Sash Lock Color, Classic Series: Color as selected from manufacturer's standard colors.
   6. Window Opening Control Device and Color: Provide device to restrict operable sash to less than four inches maximum clear opening, releasable in compliance with ASTM F2090, Color as selected from manufacturer's standard colors.

H. Insect Screens:
   1. Type: Conventional.
      a. Frame Material: Aluminum.
      b. Painted Finish and Color: Factory-applied baked-on silicone polyester enamel Match window frame.

2.4 NON-IMPACT-RESISTANT GLAZING

A. A: Thermal Transmission (U-Factor), NFRC 100:
   1. Casement: 0.29 without grilles.
   2. Casement fixed: 0.27 without grilles.

B. Solar Heat Gain Coefficient (SHGC), NFRC 200:
   1. Casement: 0.31 without grilles.
   2. Casement fixed: 0.34 without grilles.

C. Visible Light Transmittance (VLT), NFRC 200:
   1. Casement: 0.54 without grilles.
   2. Casement fixed: 0.60 without grilles.

D. Sound Transmission Class (STC)/Outdoor Indoor Transmission Classification (OITC), ASTM E90:
   1. Casement: 26/22.
   2. Casement fixed: 29/25.

E. Glass Units: Provide insulating glass units certified through Insulating Glass Certification Council as conforming to the requirements of IGCC and ASTM E2190.
   1. Manufacturer Designation: Andersen Low-E4 Glass.
   2. Glazing Configuration: Dual-pane.
   3. Seal and Spacer Type: Dual sealed insulating glass units with polyisobutylene primary seal, silicone secondary seal and stainless steel spacers.
   4. Glass Type: Annealed glass, ASTM C1036 and Fully tempered glass, ASTM C1048 where indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that all substrate conditions are suitable for installation in compliance with manufacturer's recommendations.

B. Do not begin installation until substrates have been properly prepared and any conditions not in compliance with manufacturer's recommendations have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's product recommendations, including but not limited to the Andersen Unit Installation Guide, installation information in product literature and on product packaging. Comply with Drawings and Shop Drawings for installing windows, hardware, accessories, and other components.

B. Install windows plumb, level and square. Anchor windows securely to structure in correct orientation to flashing and adjacent construction as indicated. Comply with product installation instructions for proper flashing integration into wall system. Install windows so as to drain water penetration to the exterior.

C. Adjust sashes, insect screens, ventilators, hardware and accessories as applicable for correct fit. Adjust weatherstrip for smooth operation and weather-tight closure.

3.3 CLEANING

A. Remove protective films and non-permanent labels prior to 90 days after installation.

B. Remove excess sealant, soiling, dirt and other substances. Clean window frame and glass surfaces. Avoid damaging coatings and finishes.

C. Touch-up, repair or replace glass or other window components broken, scratched or damaged during construction prior to Substantial Completion.

D. Remove and lawfully dispose of construction debris from Project site

3.4 PROTECTION

A. Protect installed windows and finish surfaces from damage during construction until completion of Project and acceptance by Owner.

END OF SECTION

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 commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

   1. Function of building, purpose of each area and degree of security required.
   2. Plans for existing and future key system expansion.
   3. Requirements for key control storage and software.
   4. Installation of permanent keys, cylinder cores and software.
   5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Where specified, provide modular continuous geared hinges that ship in two or three pieces and form a single continuous hinge upon installation.
2. Manufacturers:.

a. Pemko (PE).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

a. Rockwood (RO).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.

4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

    a. Rockwood (RO).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:

    a. Medeco (MC) - X4.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Control Keys (where required): Two (2).
4. Permanent Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) 4700LN Series.

2.6 DEADLOCKS AND LATCHES

A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - D100 Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

    a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    c. Five-year limited warranty for mechanical features.

2. Manufacturers:

    a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 6000 Series.

2.9 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

    a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - Unitrol Series.

C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:

    a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - 3500 Series.

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Rockwood (RO).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION 087100

PART 1 GENERAL

1.1 SUMMARY

A. Section includes glass and infill panels for metal frames, doors, curtain wall, etc.
   1. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.

B. Related Sections:
   1. Section 079000 - Joint Sealers: Sealant and back-up material.
   2. Section 081120 – Standard Steel Frames: Vision Panels: glazed vision panels.
   3. Section 084100 - Aluminum Storefronts: glazing in storefronts.
   4. Section 088813 – Fire Rated Glass

1.2 REFERENCES

A. American National Standards Institute: ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

B. American Society of Civil Engineers: ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. American Society for Testing and Materials:
   1. ASTM C570 - Standard Specification for Oil- and Resin-Base Caulking Compound for Building Construction.
   2. ASTM C669 - Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash.
   3. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
   4. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
   5. ASTM C1036 - Standard Specification for Flat Glass.
   6. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
   7. ASTM C1193 - Standard Guide for Use of Joint Sealants.
   8. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   9. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
   10. ASTM E546 - Standard Test Method for Frost Point of Sealed Insulating Glass Units.
   11. ASTM E576 - Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.
   12. ASTM E773 - Standard Test Methods for Seal Durability of Sealed Insulating Glass Units.
   13. ASTM E774 - Standard Specification for Sealed Insulating Glass Units.
   14. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Exterior Windows and Doors.

D. Glass Association of North America:
   1. GANA - FGMA Sealant Manual.
   2. GANA - Glazing Manual.

E. National Fire Protection Association: NFPA 80 - Standard for Fire Doors, Fire Windows.

F. Underwriters Laboratories Inc.: UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
   1. In conjunction with materials described in Section 079000.
   2. To utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
   3. To maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.

B. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass as calculated in accordance with applicable code.

C. Limit glass deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.

1.4 SUBMITTALS

A. Under provisions of Division 1 - General Requirements: Submittals.

B. Product Data:
   1. Glass: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
   2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

C. Samples:
   1. Glass: Submit two samples 12 x 12 inch in size, illustrating each glass, insulated glass unit, infill panel, coloration and design.
   2. Glazing Materials: Submit 6-inch long bead of glazing sealant and color.

D. Certificates: Certify products meet or exceed specified requirements.

E. Manufacturer's Certificate: Certify sealed insulated and fire-rated glass, meets or exceeds specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETING

A. Under provisions of Division 1 - General Requirements: Preconstruction Conference.

B. Convene minimum one week before starting Work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install glazing when ambient temperature is less than 50 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

A. Furnish warranties under provisions of Division 1 - General Requirements: Warranties

B. Furnish ten-year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 GLAZING

A. Flat Glass Manufacturers:
1. AFG Industries, Inc.
2. Pilkington L.O.F. Glass Company.
3. Pittsburgh Plate Glass.
4. Or approved equal.

B. Sealed Insulating Glass Manufacturers:
1. Viracon.
2. Architectural Aluminum & Glass Co., Inc.
3. Guardian Industries Corp.
4. Or approved equal.

C. Glazing Sealant Manufacturers (Acrylic):
1. C.R. Laurence Co., Inc., Model: 800 Acrylic Latex.
2. Tremco, Model: Tremflex 834.
3. Schnee-Morehead.
4. Or approved equal.

D. Glazing Accessories Manufacturers (Neoprene):
1. C.R. Laurence Co., Inc.
2. H-O Products Corp.
3. Norton.
4. Or approved equal.

2.2 COMPONENTS

A. Insulated Glass Units: Total unit thickness 1 inch. **Type G-1.**
1. Double Pane Insulated Glass Units (Type IG-DP): ASTM E774 Class A and E773; with glass elastomer edge seal; purge interpane space with dry hermetic air.
   a. Insulated Vision Glass Units with 1/2” air space.
   1) Outer Pane: Glass Type: SG-CT, Grey tinted, tempered glass, 1/4 inch thick, Viracron ‘Solarscreen 2000' VE-2M, type Low-E coating on the #2 surface horizontally heat strengthened or approved equal.
   2) Inner Pane: Glass Type: SG-CT, Clear tempered glass, 1/4 inch.

B. Insulated Glass Units: Total unit thickness 1 inch. **Type G-2.**
1. Double Pane Insulated Glass Units (Type IG-DP): ASTM E774 Class A and E773; with glass elastomer edge seal; purge interpane space with dry hermetic air.
   a. Tempered Insulated Vision Glass Units with 1/2” air space.
   1) Outer Pane: Glass Type: SG-CT, Grey tinted, tempered glass, 1/4 inch thick, Viracron ‘Solarscreen 2000' VE-2M, type Low-E coating on the #2 surface horizontally heat strengthened or approved equal.

2) Inner Pane: Glass Type: SG-CT, Clear tempered glass, 1/4 inch.

C. Safety Glass: Total thickness ¼". **Type G-3**.
1. Clear Tempered Glass (Type SG-CT): ASTM C1048, Kind FT Fully tempered, Condition A, uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.

D. Selections may be changed; selections are for bidding purposes only.

2.3 ACCESSORIES

A. Glazing Materials: Storefront, window and curtain wall manufacturer's standard types to suit applications and to achieve weather, moisture, and air infiltration requirements.

B. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
1. Acrylic Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, solvent curing, non-bleeding; cured Shore A hardness of 15 to 25.
   a. Type: Tremflex 834, manufactured by Tremco, or approved equal.
   b. Color: From manufacturer's standards, as selected by Architect.

C. Setting Blocks: ASTM C864 Option I, Neoprene, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4-inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

D. Spacer Shims: ASTM C864 Option I, Neoprene, 50 to 60 Shore A durometer hardness, minimum 3-inch long x one half the height of glazing stop x thickness to suit application, self-adhesive on one face.

E. Glazing Clips: Manufacturer's standard type.

F. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

G. Selections may be changed; selections are for bidding purposes only.

PART 3 EXECUTION

3.1 EXAMINATION

A. Under provisions of Division 1 - General Requirements: Coordination.

B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
   1. Glazing Sealants: Comply with ASTM C1193.
   2. Fire Rated Openings: Comply with NFPA 80

B. Exterior Wet/Dry Method (Preformed Tape and Sealant) Installation:
   1. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with compatible butyl sealant.
   2. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapor seal.
   3. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   4. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
   5. Install removable stops, with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line.
   6. Fill gap between glazing and stop with elastomeric glazing sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
   7. Apply cap bead of elastomeric glazing sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

C. Interior Wet/Dry Method (Tape and Sealant) Installation:
   1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
   4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
   5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
   6. Trim protruding tape edge.

3.4 FIELD QUALITY CONTROL

A. Monitor quality of glazing.

3.5 CLEANING

A. Clean glazing under provisions of Division 1 - General Requirements: Final Cleaning.
B. Remove glazing materials from finish surfaces.
C. Remove labels after Work is complete.
D. Clean glass and adjacent surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Gypsum board assemblies.

B. Principal Products:

1. Gypsum board.
2. Exterior-rated gypsum board.
3. Abuse-resistant gypsum board.
4. Tile backer panels.
5. Installation accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate work of this section with wall and ceiling framing.

B. Preinstallation Meeting:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data.

1. Each type of gypsum board.
2. Cementitious tile backer board.
3. Trim accessories.
4. Sound attenuation blankets.

B. Samples:

1. Trim Accessories: 12-inch lengths of trim other than edge beads and control joints.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Panel Products:

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.

4. USG Corporation.
5. Or approved equal.

2.2 GYPSUM BOARD FOR INTERIOR APPLICATIONS

A. Fire-Resistant Gypsum Board: ASTM C1396.

1. Core: 5/8 inch, Type X; locations shown on Drawings.

B. Abuse-Resistant Gypsum Board: ASTM C1629.

1. Manufacturers and Products:

a. CertainTeed Extreme Abuse Resistant Gypsum Board.
b. Georgia-Pacific Gypsum DenArmor Plus Fireguard Abuse-Resistant.
c. National Gypsum Gold Bond Hi-Abuse XP Gypsum Board.
d. USG Corp Sheetrock Mold Tough AR Firecode X.
e. Or approved equal.

2. Core: 5/8 inch, Type X.
3. Surface Abrasion: Level 3 requirements.
4. Surface Indentation: Level 1.
5. Single-Drop Soft-Body Impact: Level 2.
6. Mold Resistance: 10 per ASTM D3273.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396.

1. Manufacturers and Products:

a. CertainTeed M2Tech Mold Resistant.
b. Georgia-Pacific Gypsum ToughRock Mold-Guard.
c. National Gypsum Gold Bond XP.
d. USG Corp Sheetrock MoldTough.
e. Or approved equal.

2. Core: 5/8 inch Type X.
3. Mold Resistance: 10 per ASTM D3273.

2.3 GYPSUM BOARD FOR EXTERIOR APPLICATIONS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.

1. Core: See Drawings.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or C1325.

1. Thickness: 5/8 inch.
2. Mold Resistance: 10 per ASTM D3273.

2.5 PERFORMANCE

A. Fire Resistance:

1. Fire-Rated Assemblies: Materials and construction identical to those tested per ASTM E119 for rating shown.

B. Acoustic Performance:

1. STC-Rated Assemblies: Assemblies tested per ASTM E90 and classified per ASTM E413. See Drawings for STC ratings.

2.6 INSTALLATION MATERIALS

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet.
2. Shapes: Cornerbead.

B. PVC Trim: ASTM C1047 and ASTM D3678.

1. Manufacturers:

a. ClarkDietrich.
b. Plastic Components, Inc.
c. Trim-Tex Inc.
d. Or approved equal.

2. Shapes: Cornerbead.

C. Exterior Trim: ASTM C1047.

1. Material: Galvanized steel sheet.
2. Shapes: See Drawings.

D. Sound Attenuation Blankets: ASTM C665, Type I, unfaced semi rigid mineral wool or fiberglass, thickness shown on Drawings, sized for friction fit.

1. Surface Burning Characteristics: ASTM E84.

a. Flame Spread: 25 maximum.
b. Smoke Developed: 50 maximum.

2. Fire Rated Partitions: Insulation type required by fire resistance designs referenced on Drawings.
3. Thickness: See Drawings.

E. Acoustic Sealant: ASTM C834; nonsag, paintable, nonstaining, butyl-free, latex sealant. Supply fire rated sealant for use in fire rated assemblies.

1. Manufacturers and Products:

a. Accumetric LLC BOSS 824 Acoustical Sound Sealant.
b. GE Construction Sealants RCS20.

c. Grabber Construction Products Acoustical Sealant GSC.
d. Hilti, Inc. CP509 Smoke and Acoustical Sealant.
e. Pecora Corporation AC-20 FTR.
f. Specified Technologies, Inc. Smoke N Sound Acoustical Sealant.
g. USG Corporation SHEETROCK Acoustical Sealant.
h. Or approved equal.

F. Electrical Box Pads: Moldable non-curing one component, intumescent, fire-rated material for through-penetration fire stop systems and sound attenuation systems; self-adhering; 1/8 inch thick, minimum.

1. Manufacturers and Products:

a. Kinetics Noise Control Fire-Rated Isobacker.
b. Specified Technologies, Inc. SpecSeal Firestop Putty Pads.
c. Or approved equal.

G. Thermal Insulation and Vapor Retarder: Specified in Section 072100.

H. Fasteners for Gypsum Board:

1. Metal Framing 33 mils Thick and Less: ASTM C1002, Type S.
2. Metal Framing Greater than 33 mils Thick: ASTM C954.
3. Wood Framing: ASTM C1002, Type W.

I. Fasteners for Tile Backer Board and Exterior Gypsum Soffit Board: Board manufacturer standard, corrosion resistant steel.

J. Laminating Adhesive: Type as recommended for directly adhering gypsum panels to continuous substrate.

K. Joint Materials:

1. Interior Gypsum Board: ASTM C475/C475M; products compatible with substrate and other coatings applied to surface.

a. Skim Coat For Final Coat of Level 5 Finish: Spray-applied high-build coating.

2. Tile Backer Board: Product recommended by backer unit manufacturer.
3. Exterior Gypsum Soffit Board: Setting-type taping compound and setting-type, sandable topping compound.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations and sizes of framing supports for openings and penetrations.

B. Examine panels for moisture and mold; discard damaged panels.

3.2 INSTALLATION - GENERAL

A. Install control joints in accordance with ASTM C840 and as directed on Drawings.

3.3 INSTALLATION - ACOUSTICAL ACCESSORIES

A. STC-Rated Assemblies: Follow assembly designs shown on Drawings.

B. Comply with ASTM C919 for locations of acoustical sealant beads. Close off sound-flanking paths around or through the work, including sealing of partitions above acoustical ceilings.

C. Do not install sound attenuation blankets until mechanical and electrical work within framing spaces is complete.

D. Fill framing spaces for complete coverage after gypsum board has been installed on one side of partition.

E. Fit sound attenuation blankets tight around cut openings and penetrations, and behind and around electrical and mechanical items within framing spaces.

F. Pack blankets around door and window frames, between jamb studs, in boxed headers, and in other voids.

G. Provide wires or other means of mechanical supports to maintain full coverage and prevent insulation displacement.

H. Where concealed acoustical sealant beads are required at floor line, apply sealant to clean floor surface first and set gypsum boards into wet sealant.

I. At other locations tool beads to ensure complete contact with joint surfaces. Where exposed, form smooth concave surface suitable for finish painting.

J. Ceilings:

1. Install blankets in continuous layer with tightly butted edges.
2. Place blankets over pipes, wiring, electrical boxes, and other construction without voids.

3.4 ELECTRICAL BOX SEALS

A. Install seals before installing gypsum board.

B. Overlap front edge of box so that seals will be compressed around edges of box as gypsum panels are installed.

C. Applications:

1. Electrical boxes in fire barriers, smoke barriers, and STC-rated walls.
2. Electrical boxes at interior gypsum board faces of exterior walls.

3.5 INSTALLATION - INTERIOR GYPSUM BOARD

A. Comply with ASTM C840.

1. Fire-Rated Partitions: Comply with tested designs referenced on Drawings.
2. Acoustically-Rated Partitions: Comply with tested designs referenced on Drawings.

B. Cementitious Backer Units: Comply with ANSI A108.11.

1. Locations: showers and walls behind tile.

C. Cut panels to fit obstructions and openings without tearing face paper or cracking core.

D. Install panels with face side out with lightly butted joints.

E. Stagger joints on opposite sides of partitions.

F. Locate panel ends over support framing.

G. Fit panels to ducts, pipes, conduit, and other penetrations and obstructions with maximum 1/4 inch joints.

H. Attach gypsum board to framing and to supplementary framing and blocking provided for additional support at openings and cutouts.

I. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

J. Isolate perimeter of non-loadbearing drywall partitions from structural members. Provide 1/4 to 1/2-inch space and trim edge with edge bead. Seal joints with acoustical sealant.

K. Single Layer Installation:

1. Install panels vertically with long edges on continuous supports.
2. Attach panels to framing with screws.

L. Double Layer Installation:

1. Attach base layer to framing with screws.
2. Offset second layer joints and attach panels with screws and adhesive.
3. At walls taller than 9 feet, install panels horizontally and provide control joints at floor lines.

3.6 INSTALLATION - EXTERIOR GYPSUM BOARD

A. Install panels perpendicular to supports with staggered end joints.

B. Fit panels with 1/4 inch joints at adjacent construction and penetrations.

C. Fasteners: Corrosion-resistant screws.

3.7 INSTALLATION - TRIM

A. Vertical Trim: Install in single pieces where length is 9 feet or less.

B. Control Joints: Install per ASTM C840 and as follows.

1. Locations of control and expansion joints in substrate or framing.
2. Walls:

    a. At changes in backup material.
    b. Above one jamb of doors, unless door frame extends to ceiling.
    c. Maximum 30 feet on center.

3. Ceilings:

    a. At locations where ceiling framing or furring changes direction.
    b. Maximum 50 feet on center.

C. Corner Bead: Outside corners.

D. Casings: Install at termination joints with other construction or where edges are exposed.

E. Reveals: Install trim plumb, level, accurately aligned, and fitted neatly with hairline joints.

1. Cut trim with sharp power saw and file cut edges to remove burrs.
2. Miter joint at changes in direction or plane, except that inside corners may be coped.
3. Apply masking tape or other protection to reveal surfaces before starting drywall finishing.
4. Rated Fire and Smoke Barriers and Non-Rated Smoke Partitions: Install reveals to maintain rating.
5. Routing of gypsum board to create reveals is not acceptable.

3.8 FINISHING

A. Reference Standard: ASTM C840.

B. Finish panel joints, inside corners, trim flanges, fastener heads, and surface defects to provide smooth, continuous surfaces of monolithic appearance that are suitable for applied finishes.

C. Do not fill spaces around penetrations through fire resistive assemblies with joint compound. Leave space for firestopping.

D. Finish Levels:

1. Level 1: Surfaces in plenums and other concealed areas.
2. Level 2: Surfaces that receive tile.
3. Level 3: Not used.
4. Level 4: Surfaces that receive flat or low sheen paint and wall coverings.
5. Level 5: surfaces that are in edge-lit locations.

E. Exterior Gypsum Board: Fill joints and embed tape with setting type joint compound. Apply first, fill (second), and finish (third) coats, with third coat being sandable product. Sand between coats and after finish coat.

3.9 IDENTIFICATION

A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations.

1. Locations: Within 4 ft of corners and maximum 12 feet between on both sides.

a. In spaces without ceilings, locate signs minimum 10 ft above finish floor and not blocked from view by ducts, structure, or other elements.

2. Signs: Painted stencil signs with minimum 4-inch high letters and 1/2-inch strokes, or as required by authorities having jurisdiction, or approved self-adhesive signs.
3. Text: Use following or as required by authorities having jurisdiction.

a. 1-HOUR FIRE BARRIER – FIRESTOP ALL PENETRATIONS.
b. 2-HOUR FIRE BARRIER – FIRESTOP ALL PENETRATIONS.
c. 3-HOUR FIRE WALL – PENETRATIONS NOT PERMITTED.
d. NON-RATED SMOKE PARTITION – SEAL ALL PENETRATIONS.

3.10 FIELD QUALITY CONTROL

A. Coordinate installation of gypsum board ceilings, soffits, and bulkheads to accommodate observations by Architect and authorities having jurisdiction.

3.11 ADJUSTING

A. Remove interior gypsum products exposed to water during construction period. Remove entire gypsum board panels; do not cut and patch gypsum board.

3.12 CLEANING

A. Remove spills, spatters, and misapplications of finishing materials as they occur.

B. Repair other finish surfaces damaged during drywall operations.

3.13 PROTECTION

A. Protection:

1. Protect adjacent surfaces from gypsum panel compounds, adhesives, and sealants
2. Protect finished gypsum panels from being marred from ongoing work.

END OF SECTION

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. Floor and wall tile.
2. Stone thresholds.
3. Crack isolation membrane.
4. Tile backing panels.
5. Metal edge strips.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for preparation of floor construction for tile application.
2. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 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.

1.4 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.

1.5 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.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and 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.

1.7 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.

1.8 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 A108.02, 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.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Floor and wall tile

1. Basis-of-Design Product: Subject to compliance with requirements, provide *Overall* porcelain tile by Garden State Tile (FOR BIDDING PURPOSES) or comparable product by one of the following:

    a. American Olean; Division of Dal-Tile International Inc.
    b. Crossville, Inc.
    c. Or approved equal.
2. Module Size: 12” x 24”
3. Thickness: 10mm
4. Surface: Slip-resistant, with abrasive admixture.
5. Finish: Matte, opaque glaze.
6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. 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, module size 3 by 24 inch.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2. Full width of frame opening.

2.4 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.5 SETTING MATERIALS

A. 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. Boiardi Products; a QEP company.
b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEI Corporation.
i. Mer-Kote Products, Inc.
j. Southern Grouts & Mortars, Inc.
k. Summitville Tiles, Inc.
l. TEC; a subsidiary of H. B. Fuller Company.
m. Or approved equal.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.6 GROUT MATERIALS

A. Sanded Grout: ANSI A118.6, and CRD C-621 - 'Hydromet' Portland cement grout with colorfast pigments and high strength aggregates as manufactured by Bostik (tile floors and base). Colors as selected by Architect.

B. Unsanded Grout: ANSI A118.6 - 'Hydromet' dry tile grout of Portland cement, ground quartz and colorfast pigments and high strength aggregates as manufactured by Bostik or approved equal (tile walls). Colors as selected by Architect.

2.7 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. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. 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.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.8 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 thin-set mortar comply with surface finish requirements in ANSI A108.01 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 adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

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 in wet areas.
   b. 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. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. 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. Floor Tile: 1/4 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. 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.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

3.5 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.

END OF SECTION 093000

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Acoustical panel ceiling systems.
2. Specialty ceiling systems.

B. Principal Products:

1. Acoustical ceiling panels.
2. Specialty ceiling components.
3. Suspension grids.
4. Edge trims.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate work results of this Section with ceiling-supported elements.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Lighting installers, ceiling-mounted HVAC installers, and fire suppression work.

C. Sequencing:

1. Complete ceiling suspension system and panel installation after overhead HVAC, electrical, and fire-suppression work is tested and approved.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Acoustical panels.
2. Specialty ceiling panels.
3. Specialty ceiling baffles.
4. Suspension grid and trim.
5. Initial selection color and texture brochure and samples.

B. Shop Drawings.

1. Show grid layout and panel identification for each acoustical panel ceiling.
2. Show layout, suspension, and terminations of all specialty ceiling systems.
3. Include mechanical and electrical items installed in ceilings.
4. Installation details for seismic design loads sealed by professional engineer responsible for seismic attachment and bracing design.

C. Samples:

1. Each acoustical panel type, standard and 12- by 12-inch size.
2. Each suspension grid type, 12-inch lengths with required colors.
3. Extruded aluminum trim, 12-inch lengths with required colors.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality Control Submittals: Field reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty Documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Acoustical Panels: Unused panels plus a minimum of 96 square feet of each product installed.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Licensed Professionals: Registered in the State of New Jersey.

B. Field Samples: Construct acoustical ceilings, 96 by 96 inches, minimum size. Include decorative edge trim in sample.

1. Approved samples establish work results standard.
2. Approved samples may become a part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products after building is fully enclosed.

1.9 FIELD CONDITIONS

A. Ambient Conditions: Perform work within the following limitations.

1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Panels:

1. Armstrong World Industries, Inc. (Basis of Design)
2. Or approved equal.

2.2 ACOUSTICAL CEILING UNITS

A. ACT Type 1

1. Acoustical Panels Type AP
2. Surface Texture: Fine
3. Composition: Mineral Fiber
4. Color: White
5. Size: 24" x 24"
6. Edge Profile: Angled Tegular 15/16" for interface with PRELUDE XL 15/16" Exposed Tee grid.
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.50
8. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 35.
9. Sabin: N/A
10. Articulation Class (AC): N/A
11. Flame Spread: ASTM E 1264; Class A (UL)
12. Light Reflectance (LR) White Panel: ASTM E 1477; 0.81
13. Dimensional Stability: HUMIGUARD Plus
14. Recycle Content: Post-Consumer - 0% - 1% Pre-Consumer - 29% - 43%
15. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
16. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
17. Acceptable Product: DUNE, 1774 No added formaldehyde as manufactured by Armstrong World Industries or approved equal.

B. ACT Type 2

1. Acoustical Panels Type AP
2. Surface Texture: Fine
3. Composition: Mineral Fiber
4. Color: White
5. Size: 24" x 48"
6. Edge Profile: Angled Tegular 15/16" for interface with PRELUDE XL 15/16" Exposed Tee grid.
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.50
8. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 35.
9. Sabin: N/A
10. Articulation Class (AC): N/A
11. Flame Spread: ASTM E 1264; Class A (UL)
12. Light Reflectance (LR) White Panel: ASTM E 1477; 0.81
13. Dimensional Stability: HUMIGUARD Plus

14. Recycle Content: Post-Consumer - 0% - 1% Pre-Consumer - 29% - 43%
15. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
16. Life Cycle Assessment: Third Party Certified Environment Product Declaration (EPD)
17. Acceptable Product: DUNE, 1776 No added formaldehyde as manufactured by Armstrong World Industries or approved equal.

2.3 SUSPENSION GRID

A. Non-Fire-Rated Grid: ASTM C635, intermediate duty.

1. Manufacturers and Products: See Finish Schedule on Drawings.
2. Manufacturers:

    a. Armstrong World Industries, Inc.
    b. CertainTeed Corp.
    c. Rockfon.
    d. USG Interiors.
    e. Or approved equal.

3. Material: Steel; ASTM A653 G30 hot dip galvanized.
4. Flange Caps: Painted steel, 15/16 inch wide.
5. Cap Color: Architect Selected.

B. Fire-Rated Grid: Same attributes as non-rated grid but listed by UL for indicated fire-resistance rating.

C. Hold-Down Clips: Supplied by ceiling system manufacturer; tested for listed fire-rated assemblies.

D. Impact Clips: Supplied by ceiling system manufacturer.

2.4 CEILING TRIM

A. Wall Moldings:

1. Material: Aluminum, painted finish matching grid.
2. Profile: See Drawings.

B. Decorative Ceiling Edge Trim: Extruded aluminum with concealed attachment to suspension grid and flush, splined joints; factory finished.

1. Manufacturers and Products:

    a. Armstrong Axiom.
    b. CertainTeed Terminus.
    c. Rockfon Infinity.
    d. USG Compasso.
    e. Or approved equal.

2. Height: See Drawings.
3. Color: Architect selected.

2.5 INSTALLATION MATERIALS

A. Hanger Attachment: Five times design load per ASTM C635, Table 1.

B. Wire Hangers: Galvanized steel wire.

1. Diameter: Sized for three times hanger design load per ASTM C635, Table 1.

C. Acoustical Insulation: ASTM C665; unfaced fiberglass blankets, see Drawings for thickness.

D. Touch-up Paint: Type and color to match acoustic and grid units.

2.6 FABRICATION

A. Fabricate decorative edge trim at factory to accurate curves without flat spots, kinks, or other distortion.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that hanger layout will not interfere with other work.

B. Examine acoustical panels; discard panels that are wet, damaged, or exhibit mold.

C. Verify that major work above ceiling is complete and inspected before installing grid.

3.2 INSTALLATION

A. Installation Reference Standards:

1. ASTM C636.
2. CISCA Ceiling Systems Handbook.
3. Seismic Standard: ASTM E580/E580M.

B. Deflection: 1/360, maximum, when fully loaded.

C. Grid Layout:

1. Locate system on room axis according to reflected plan.
2. Locate system to balanced grid design with edge units not less than 50 percent of acoustic unit size. Arrange system with long dimension of panels parallel to long dimension of the space.

D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible face plane displacement between adjacent members.

E. Where ducts or other equipment prevent regular hanger spacing, reinforce hangers to span extra distance or suspend steel channels horizontally and fasten hangers to channels.

F. Install decorative edge trim with plumb faces, concealed fasteners, and aligned joints.

G. Install grid so that components are level and accurately aligned.

H. Support tees on perimeter molding flanges.

I. Perimeter Moldings: Fasten to substrates 16 inches on center, maximum.

1. Install edge moldings at intersections of ceiling and vertical surfaces in acoustical sealant bed or with continuous gasket.
2. Use longest practical lengths.
3. Outside Corners: Miter or overlap molding.
4. Inside Corners: Cut flanges and bend webs.
5. At round obstructions or penetrations, install factory-formed closures that match perimeter molding.

J. Rated Ceilings: Install acoustical panels light fixture boxes per UL assembly requirements and fixture ventilation requirements.

K. Lay directional pattern units with pattern running one direction.

L. Place acoustical panels with edges resting flat on suspension grid in uniform plane free of warping.

M. Cutting Acoustical Panels:

1. Cut to fit irregular grid and perimeter edge trim.
2. Cut profiles to match factory edges.
3. Field paint exposed cut edges.

N. Lay acoustical insulation blankets in close contact to distance of 48 inches on both sides of partitions with acoustical insulation.

O. Install hold-down and impact clips at manufacturer recommended spacing.

3.3 TOLERANCES

A. Plane: 1/8 inch variation in 10 feet, maximum, measured in any direction.

B. Grid Plumbness: 2 degrees rotation variation, maximum.

3.4 ADJUSTING

A. Touch up minor scratches and abrasions to match factory finish.

B. Provide new components to replace damaged components that cannot be satisfactorily cleaned or repaired.

END OF SECTION

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.

B. Related Sections:

1. Division 09 Section "Resilient Flooring" for resilient floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

1.4 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

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 (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), 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 (13 deg C) or more than 95 deg F (35 deg C)

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL 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. Tarkett.
   c. Roppe Corporation, USA.
   d. Or approved equal.

B. Resilient Base Standard: ASTM F 1861.

C. Minimum Thickness: 0.125 inch.

D. Height: 6 inches.

E. Lengths: 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 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.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

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.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. 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.

C. 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.

D. 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. Preformed Corners: Install preformed corners before installing straight pieces.

G. 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 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.

END OF SECTION

SECTION 096519 - 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. Luxury Vinyl Tile

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size samples of each resilient product color, texture, and pattern required.

D. Product Schedule: For resilient products. Use same designations indicated on Drawings**.**

1.4 QUALITY ASSURANCE

A. Installation Qualification: Contractors for floor covering installation should be experienced in managing commercial flooring projects and provide professional installers, qualified to install the various flooring materials specified. An installer is “qualified” if trained, or a certified by Tarkett or a certified INSTALL (International Standards & Training Alliance) resilient floor covering installer.

B. Mockups: Provide resilient products with mockups specified in other Sections.

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 Tarkett, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

1.6 PROJECT CONDITIONS

A. Install resilient products after other finishing operations, including painting, have been completed.

B. Maintain ambient temperatures within range recommended by Tarkett, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

C. Maintain the ambient relative humidity between 40% and 60% during installation.

D. Until Substantial Completion, maintain ambient temperatures within range recommended by Tarkett, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 - PRODUCTS

2.1 RESILIENT SHEET FLOORING

A. Manufacturer:
1. Tarkett North America
2. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, 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.

B. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 LUXURY VINYL FLOOR

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Patcraft ‘Anew’ resilient plank FOR THE PURPOSES OF BIDDING
2. Or approved equal.

B. Thickness: .098”.

C. Size: 7.75” x 48”.

D. Colors and Patterns: As selected by Architect from full range of manufacturer’s colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

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 Tarkett written instructions to ensure proper adhesion of Resilient Flooring.
   1. Prepare concrete substrates in accordance with ASTM F 710.
      a. Concrete floors must be free of dust, solvent, paint, wax, oil, grease, residual adhesive, adhesive removers, film-forming curing compounds, silicate penetrating curing compounds, sealing, hardening or parting compounds, alkaline salts, excessive carbonation or laitence, mold, mildew, and other foreign materials that may affect dissipation rate of moisture from the concrete, discoloration or adhesive bonding.
      b. Mechanically remove contamination on the substrate that may cause damage to the resilient flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
      c. Perform moisture testing as recommended by manufacturer. Proceed with installation only after substrates have been tested and meet the minimum requirements from the manufacturer in accordance with ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
      d. A pH test for alkalinity must be conducted on the concrete floor prior to installation with results conforming to manufacturer requirements. If the test results are not within the acceptable range, then installation must not proceed until the problem has been corrected.
   2. Wood subfloors must have a minimum 18" (45.7 cm) of cross-ventilated space beneath the bottom of the joist.
      a. The floor must be rigid, free of movement.
      b. Single wood and tongue and groove subfloors should be covered with ¼" (6.4 mm) or ½" (12.7 mm) APA approved underlayment plywood.
         1) Use ¼" (6.4 mm) thick underlayment panels for boards with a face width of 3" (76 mm) or less.
         2) Use ½" (12.7 mm) thick underlayment panels for boards with a face width wider than 3" (76 mm).
      c. Do not install over OSB (Oriented Strand Board), particle board, chipboard, lauan or composite type underlayments.

B. Fill cracks, holes, depressions and irregularities in the substrate with good quality Portland cement based underlayment leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Floor covering shall not be installed over expansion joints.

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 TILE FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient tile flooring.

B. Vinyl Composition Flooring:
   1. Install with manufacturer’s recommended adhesive specified for the site conditions and follow adhesive label for proper use.
   2. Follow manufacturer’s recommendation for tile orientation.
   3. Open enough cartons of floor tiles to cover each area, and mix tile to ensure shade variations do not occur within any one area.
   4. Roll the flooring in both directions using a 100 pound three-section roller.

C. Comply with manufacturer's written instructions for installing floor tile.

D. 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.

E. 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.

F. 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.

G. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

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 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.
   1. No traffic for 24 hours after installation.
   2. No heavy traffic, rolling loads, or furniture placement for 48 hours after installation.

D. Wait 48 hours after installation before performing initial cleaning.

E. A regular maintenance program must be started after the initial cleaning.

END OF SECTION

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. Carpet tile placed with glue-down method and accessories.
2. Walk-off Carpet Tile

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.6 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:

1. Patcraft ‘Artefact’. For the purposes of bidding.

2. Mannington Commercial ‘Ruffian II 38 oz’ (walk-off mat).

3. Or approved equal.

B. Color: As selected by Architect from manufacturer's full range.

C. Size: 12 by 48 inches.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in Division 06 Section "Sheathing."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

F. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface preparation and field application of paints and coatings.

B. Related Sections:
1. Division 06 Section – Finish Carpentry
2. Division 08 Section – Standard Steel Frames
3. Division 09 Section – Gypsum Board Systems

1.2 REFERENCES

A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

B. Conform to ASTM D16 for interpretation of terms used in this Section.

1.3 SUBMITTALS

A. Product Data: Provide data on all finishing products and special coatings.

B. Samples: Submit samples illustrating range of colors and textures available for each surface finishing product scheduled.

C. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

D. Manufacturer’s Safety Data Sheet (MSDS) for each product used.

1.4 QUALITY ASSURANCE

A. Single Source
1. Provide primers and other undercoat paints produced by same manufacturer as finish coats for each application.
2. Use only thinners approved by paint manufacturer and use only with recommended limits.

B. Coordination of Work
1. Review other sections of these Specifications in which prime paints are to be provided, to ensure compatibility of total coatings system.
2. Upon request from other trades, furnish information or characteristics of proposed finish materials, to ensure that compatible prime coats are used.

C. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Applicator: Company specializing in performing the work of this section with minimum years documented experience and where applicable, approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Ambient temperature range for installation varies among manufacturers. Consult manufacturers for recommendations and revise first paragraph below to suit Project.

B. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior, unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.7 EXTRA MATERIALS

A. Provide 1 unopened gallon of each color, type, and surface texture to Owner.

B. Label each container with color, type, texture, and room locations, in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sherwin Williams

B. Benjamin Moore

C. PPG

D. Or approved equal.

2.2 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.3 FINISHES

A. Refer to schedule at end of section for surface finish schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions.

B. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Interior Wood: 15 percent, measured in accordance with ASTM D2016.

3.2 PREPARATION

A. Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Correct defects and clean surfaces which affect work of this section.

C. Seal with shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

F. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

G. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

I. Clean and prepare all surfaces in accordance with manufacturer's written specifications.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand wood and metal lightly between coats to achieve required finish.

F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

I. Prime concealed surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

J. Prime concealed surfaces of interior and exterior woodwork with primer paint.

K. Existing/new metal siding must be free of all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar and sealers to assure sound bonding. Glossy surfaces of old paint films must be clean and dull before repainting.

L. Check for compatibility by applying a test patch of the recommended coating system, approximately 2-3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If coating system is incompatible, complete removal is required per ASTM D4259.Retain first paragraph below for resilient base with preformed corners; retain second paragraph for resilient base with job-formed corners.

3.4 CLEANING AND PROTECTION

A. Clean work.

B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.5 SCHEDULE - INTERIOR SURFACES

A. Miscellaneous Wood – Painted:
   1. One coat of latex primer sealer: Sherwin Williams or equal: Premium Wall & Wood Primer, B28W111.
   2. Two coats of semi-gloss finish: Sherwin Williams or equal: Promar 200 Zero VOC Interior Latex Semi-Gloss B31.2600. Assume two (2) colors.

B. Steel - Unprimed:
   1. One coat of primer: Sherwin Williams or equal: Pro Industrial Procryl Primer, B66-310.
   2. Two coats of semi-gloss finish: Sherwin Williams or equal: Pro Industrial HP Acrylic, B66-600. Assume two (2) colors.

C. Steel - Primed:
   1. One coat of primer: Sherwin Williams or equal: Pro Industrial Procryl Primer, B66-310.
   2. Two coats of semi-gloss finish: Sherwin Williams or equal: Pro Industrial HP Acrylic, B66-600. Assume two (2) colors.

D. Gypsum Board:
   1. One coat of latex primer sealer, Sherwin Williams or equal: Promar 200 Zero VOC Interior Latex Primer B28-2600.
   2. Two coats of eggshell finish, Sherwin Williams or equal: Promar 200 Zero VOC Interior Latex Eg-Shel, B20-2600. Assume three (2) colors.

E. CMU:
   1. One coat primer/void filler: Sherwin Williams or equal: Heavy Duty Block Filler, B42W46.
   2. Two coats acrylic epoxy semi-gloss finish; Sherwin Williams or equal: Pro-Industrial Pre-catalyzed WB Epoxy, K46. Assume two (2) colors.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes interior signs:
   1. Braille signs for all other rooms.
   2. Braille signs for restroom identification.

B. Related Sections:
   1. Division 08 – Openings.

1.2 SUBMITTALS

A. Under provisions of Division 1 - General Requirements: Submittals.

B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, and overall dimensions of each sign type.

C. Samples: Submit two signs, 6 x 6 inch in size illustrating type, style, letter font and method of attachment.

D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

E. Colors: Provide sample chips of standard color options.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Package signs, labeled in name groups.

B. Store adhesive attachment tape at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install signs when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs

1.6 STANDARDS

A. Signage shall consist of room number and function to meet the requirements of the Americans with Disabilities Act - 1990 (ADA).

1.7 WARRANTY

A. Building letters to carry lifetime warranty against defects.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

1. Manufacturers:
   1. iSign.
   2. Gemini.
   3. Or approved equal.

2.2 GRAPHIC PROCESS

A All interior signs shall be carved type.
   1 Tactile characters shall be raised the required 1/32 inches from sign face. Glue on letters or etched backgrounds are not acceptable.
   2 All text shall be accompanied by Grade 2 braille. Braille shall be separated ½" from the corresponding raised characters or symbols. Grade 2 braille translation to be provided by signage manufacturer.
   3 Perimeter borders shall be at least 3/8".
   4 All letters, numbers and/or symbols shall contrast with their background, either light characters on a dark background or dark characters on a light background. Characters and background shall have a non-glare finish.

B Sign material shall be melamine plastic laminate, approximately 1/8" thick with contrasting core color. The melamine shall be non-static, fire-retardant and self-extinguishing. The plastic laminate is to be impervious to most acids, alkalis, alcohol, solvents, abrasives and boiling water.

C Size of letters and numbers shall be as follows:
   1 Room numbers shall be 1" for classrooms signs and 3/4" for general support signs.
   2 Lettering for room names shall be 3/4".
   3 Symbol size shall be 4".
   4 Standard Grade 2 braille shall be ½" below copy.

D Copy Position: Left justified.

2.3 SIGN SIZE

A General Support room function signs, 2½ " x length as required including number and name.

B Office signs to include number and two windows for inserts by Owner; no text. Sign size, 6" x 6".

C. Restroom signs shall be 8" x 8" with a 4" accessibility symbol, gender symbol and the verbal description placed directly below followed by Grade 2 Braille.

D. Corners: ½" radius.

2.4 DIRECTIONAL SIGNS

A. Directional signs to be 18" x 9" high; 1/16" lexan with 1-1/4" high lettering spaced ½" to allow for four lines of text. Corners to have ½" radius.

B. Signs mounted above head height or intended for viewing at more than 10 feet: Minimum character height of 3 inches.

2.5 ACCESSORIES

A Vinyl Tape Adhesive: Double sided tape, permanent adhesive and silicone adhesive as required.

B. Provide blank-out backer sheet (blank sign) for signs attached to glass face and visible from the back side.

PART 3 EXECUTION

A. INTERIOR SIGN INSTALLATION

1. Install signs after doors and wall surfaces are finished, in locations as directed by Architect/Owner.
2. Locate centerline of signs 5 feet above finished floor.
3. Position sign 2 inches minimum from strike side of door; on adjacent wall surface or door (with pairs of doors), confirm all sign locations with architect prior to installation, mount level.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid plastic toilet compartments and urinal screens.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   2. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.3 SYSTEM DESCRIPTION

A. Compartment Configurations:
   1. Toilet partitions: Floor mounted, overhead braced.
   2. Urinal screens: Wall mounted.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Include dimensioned layout, elevations, trim, closures, and accessories.
   2. Product Data: Manufacturer's descriptive data for panels, hardware, and accessories.
   3. Samples: 2 x 3 inch samples showing available colors.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years experience in manufacture of solid plastic toilet compartments with products in satisfactory use under similar service conditions.

B. Installer Qualifications: Minimum 5 years experience in work of this Section.

1.6 WARRANTIES

A. Provide manufacturer’s 25 year warranty against breakage, corrosion, and delamination under normal conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on Hiny Hiders by Scranton Products. (www.scrantonproducts.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Doors, Panels and Pilasters:
1. High density polyethylene (HDPE), fabricated from polymer resins compounded under high pressure, forming single thickness panel.
2. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
3. 1 inch thick with edges rounded to 1/4 inch radius.

4. Fire hazard classification: Not required.
5. Color: To be selected from manufacturer's full color range.

B. Aluminum Extrusions: ASTM B221, 6463-T5 alloy and temper.

C. Stainless Steel: ASTM A167, Type 304.

2.3 HARDWARE

A. Hinges:
1. 8 inches long, fabricated from heavy-duty extruded aluminum with bright dip anodized finish, wrap-around flanges, adjustable on 30-degree increments, through bolted to doors and pilasters with stainless steel, Torx head sex bolts.
2. Hinges operate on field-adjustable nylon cams, field adjustable in 30-degree increments.

B. Door Strike and Keeper:
1. 6 inches long, fabricate from heavy-duty extruded aluminum with bright dip anodized finish, with wrap-around flanges secured to pilasters with stainless steel tamper resistant Torx head sex bolts.
2. Bumper: Extruded black vinyl.

C. Latch and Housing:
1. Heavy-duty extruded aluminum.
2. Latch housing: Bright dip anodized finish.
3. Slide bolt and button: Black anodized finish.

D. Coat Hook/Bumper:
1. Combination type, chrome plated Zamak.
2. Equip outswing handicapped doors with second door pull and door stop.

E. Door Pulls: Chrome plated Zamak.

2.4 COMPONENTS

A. Doors and Dividing Panels: 55 inches high, mounted 14 inches above finished floor.

B. Pilasters: 82 inches high, fastened to pilaster sleeves with stainless steel tamper resistant Torx head sex bolt.

C. Pilaster Sleeves: 3 inches high, one-piece molded HDPE, secured to pilaster with stainless steel tamper resistant Torx head sex bolt.

D. Wall Brackets: 54 inches long, Extruded PVC fastened to pilasters and panels with stainless steel tamper resistant Torx head sex bolts.

E. Headrail: Heavy-duty extruded aluminum, anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant Torx head sex bolt and at top of pilaster with stainless steel tamper resistant Torx head screws.

F. Headrail Brackets: 20 gage stainless steel, satin finish, secured to wall with stainless steel tamper resistant Torx head screws.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install compartments in accordance with manufacturer's instructions and approved Shop Drawings.

B. Install rigid, straight, plumb, and level.

C. Locate bottom edge of doors and panels 14 inches above finished floor.

D. Provide uniform, maximum 3/8 inch vertical clearance at doors.

E. Not Acceptable: Evidence of cutting, drilling, or patching.

3.2 ADJUSTING

A. Adjust doors and latches to operate correctly.

END OF SECTION

SECTION 105230 - FIRE EXTINGUISHERS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fire extinguishers.
2. Cabinets.

B. Related Sections:
1. Section 099000 – Paints and Coatings.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI/NFPA 10 - Portable Fire Extinguishers.
2. ANSI/UL 711 - Rating and Fire Testing of Fire Extinguishers.

1.3 SUBMITTALS

A. Submit under provisions of Division 1 - General Requirements: Submittals.

B. Product Data: Provide extinguisher operational features, color, and finish.

C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code ANSI/NFPA 10 for requirements for extinguishers.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Single Source for Extinguishers and Cabinets from the following:
1. J. L. Industries, Inc.
2. Larsen.
3. Kidde
4. Or Approved Equal.

2.2 EXTINGUISHER

A. Multi-Purpose Dry Chemical, ABC Type: MP10; 10 lbs. nominal capacity, UL Rating 4A-60B-C.

2.3 CABINET

A. J.L. Industries #FX1027F10 and 1027F10 Academy Series 24" x 10½" x 3" projection with rolled edges, Full glass type with double strength glass, clear anodized finish.

B. Or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify location for bracket is suitably located and free of interferences that might restrict free access to the fire extinguisher.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install bracket such that release and all operable parts are within ADA accessible reach range and level, approximately 30 inches from finished floor to bottom and no more than 48” to top of installed extinguisher.

C. Secure rigidly in place.

D. See Architectural Plans for locations.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Toilet and washroom accessories.

B. Grab bars.

C. Attachment hardware

1.2 RELATED SECTIONS

A. Section 061600 – Rough Carpentry.

1.3 REFERENCES

A. ANSI A117.1 - Safety Standards for the Handicapped.

B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

E. ASTM A366 - Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

F. ASTM B456 - Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.4 SUBMITTALS

A. Submit under provisions of Division 1 - General Requirements.

B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 code for access for the handicapped.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on product data and instructed by the manufacturer.

1.7 COORDINATION

A. Coordinate work under provisions of Division 1 - General Requirements.

B. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bradley Corporation

B. Bobrick.

C. Or approved equal.

2.2 MATERIALS

A. Sheet Steel: ASTM A366.

B. Stainless Steel Sheet: ASTM A167, Type 304.

C. Tubing: ASTM A269, stainless steel.

D. Adhesive: Two component epoxy type, waterproof.

E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.

F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 FABRICATION

A. Weld and grind joints of fabricated components, smooth.

B. Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

C. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with minimum 1/2 inches clear of wall surface. Knurl grip surfaces.

D. Shop assemble components and package complete with anchors and fittings.

E. Provide steel anchor plates, adapters, and anchor components for installation.

2.4 KEYING

A. Supply 3 keys for each accessory to Owner.

B. Master key all accessories.

2.5 FINISHES

A. Galvanizing: ASTM A123 to 1.25 oz/sq yd. Galvanize ferrous metal and fastening devices.

B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

C. Chrome/Nickel Plating: ASTM B456, Type SC 2 satin finish.

D. Stainless Steel: No. 4 satin luster finish.

E. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1 - General Requirements.

B. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

C. Verify exact location of accessories for installation.

D. Contractor to verify all quantities prior to ordering.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions and ANSI A117.1.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Install Basic Guard in accordance with manufacturer’s instructions. Cut to fit 30" wide sink space.

3.4 SCHEDULE

A. Mirrors
   a. M1: Model 780, 18” x 36”

B. Grab Bars
   a. B1: Model 812, 18”
   b. B2: Model 812, 36”
   c. B3: Model 812, 42”

END OF SECTION

SECTION 220000 - GENERAL PROVISIONS FOR PLUMBING WORK

PART 1 - GENERAL

1.1 RELATED WORK

A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

B. Drawings and general provisions of Contract, including General Conditions, and Division 01 Specification Sections apply to work of this Section.

1.2 WORK INCLUDED

A. The work covered by this section includes the construction described in the Contract Documents including all labor necessary to perform and complete such construction, all materials and equipment incorporated or to be incorporated in such construction, and all services, facilities, tools and equipment necessary or used to perform and complete such construction. The work includes, but is not limited to the following:
   1. Domestic Water Systems.
   2. Soil, Waste, Vent and Storm Water Systems.
   3. Piping, Valves and Fittings
   4. Water Meters and Backflow Prevention Devices
   5. Insulation.
   6. Domestic Water Heaters.
   7. Pressure Tanks.
   8. Identification System.
   9. Excavation and Backfill.
   10. Cutting, Patching and Equipment Painting.
   11. Hangers, Supports and Guides.
   12. Electric Motors.
   13. Electric Motor Controllers.
   14. Internal Wiring of Factory-Assembled Prewired Equipment.
   15. Alarm Wiring, except for Fire Alarm.
   16. Rigging of Equipment.
   17. Furnishing access Doors and Frames to be installed by the General Contractor.
   18. Fire Stopping for Pipe Penetration.
   19. Pipe Penetration and Drains Counterflashing.
   20. Concrete Pads for Equipment.
   21. Alarm Initiating Devices.
   22. Wiring between Water Meter Totalizer and Remote Reading Device.

B. Related Work not Included in this Division but Specified Elsewhere
   1. Fire alarm wiring.
   2. Finish painting, except for prefinished equipment or as otherwise specified.
   3. Concrete work, except equipment inertia and floating bases.
   4. Base flashing for piping and drains.
   5. Toilet accessories.
   6. Waterproofing.
   7. Power wiring for motors and motor controllers.
   8. Installation of access doors and frames.

1.3 DEFINITIONS

A. "Provide": to supply, install, and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount, and make complete with all related accessories.

C. "Furnish" or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

F. "Wiring": raceway, fittings, wire, boxes and all related accessories.

G. "Indicated," "shown," or "noted": as indicated, shown, or noted on drawings or specifications.

H. "Similar" or "equal": of base bid manufacture, equal in quality materials, weight, size, performance, design, and efficiency of specified prof, conforming with "Base Bid Manufacturers."

I. "Reviewed" "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by Architect and/or Engineer.

J. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

K. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.

L. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

M. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

N. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

O. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

P. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

Q. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. NP: Nylon plastic.
   4. PE: Polyethylene plastic.
   5. PVC: Polyvinyl chloride plastic.

R. The following are industry abbreviations for rubber materials:
   1. CR: Chlorosulfonated polyethylene synthetic rubber.
   2. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 COORDINATION OF WORK

A. The plumbing drawings show the general arrangement of piping and appurtenances. Follow these drawings as closely as the actual construction will permit. Conform the plumbing work to the requirements shown on the drawings. Provide offsets, fittings, and accessories, which may be required but not shown on the drawings. Investigate the site, structural and finish ground conditions affecting the work, and arrange the work accordingly. Provide such work and accessories as may be required to meet such conditions.

B. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

C. Carefully check space requirements with other trades to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings.

D. Transmit to other trades all information required for work to be provided under their sections, in ample time for installation.

E. Wherever work interconnects with work specified of other trades, coordinate with the General Contractor to insure that all necessary information is presented so that all the necessary connections and equipment may be properly installed. Identify all items (valves, piping, equipment, etc.) in order that the General Contractor know where to install access doors and panels.

F. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

G. Furnish and set all sleeves for passage of pipes and conduits through structural masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.

H. Provide required supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.

I. Examine and compare the contract drawings and specifications with the drawings and specifications of other disciplines, and report any discrepancies between them to the General Contractor and obtain from him written instructions for changes necessary in the work of this Section. Install and coordinate the work of this section in cooperation with installing interrelated work. Before installation, take proper provisions to avoid interferences. All changes required in the work of the contractor, caused by his neglect to do so, to be made by him at his own expense.

J. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale similar to that of the design drawings, prepared on tracing medium of the same size as contract drawings. With these layouts, coordinate the work with the work of the contractor. Such detailed work is to be clearly identified on the drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion, however, include a set of such drawings with each set of as-built drawings. When directed by the Engineer, submit drawings for review, clearly showing the work of this section and its relation to the work of other disciplines before commencing shop fabrication or erection in the field.

K. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship and report any conditions, which prevent performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

L. Provide required anchor bolts, sleeves, inserts and supports. Direct location of anchor bolts, sleeves, inserts and supports to insure that they are properly installed. Any expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports to be paid for by the contractor.

M. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. Properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.

N. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.
   1. Right-of-Way: Lines, which pitch has the right-of-way over those that do not pitch, i.e., plumbing drains. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
   2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch on sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, drains, etc., as required to affect these offsets, transitions and changes in direction.

O. Install all plumbing work to permit the removal (without damage to other parts) of water heaters and all other equipment requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

P. Provide access panels in equipment as required for inspection and maintenance of internal parts, etc.

Q. The contractor shall coordinate his work with the work of other trades.

R. Coordinated Composite Drawings
   1. The Contractor shall prepare full coordinated composite drawings for the mechanical, electrical and fire protection trades. The Contractor shall overlay each trade's work (in separate colors) on a sepia set of sheetmetal drawings. All conflicts and potential conflicts shall be clearly identified on the sepia sheetmetal drawings. This shall include but not be limited to conflicts with lights, equipment, piping, ductwork and supports of other trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. Contractor shall have representatives of each trade attend a weekly job site coordination meeting in the Contractor's field office. All trades shall resolve conflicts at these meetings and sign off each sepia sheetmetal drawing indicating acceptance and satisfactory resolution to all conflicts. All conflicts that cannot be resolved shall be brought to the attention of the Engineer for resolution.

1.5 USE OF SITE AND LOAD LIMITATIONS

A. The contractor shall review all available data on the location and types of pipelines and other underground utilities. The contractor shall not operate equipment over the facilities and shall

take care not to damage them or otherwise impair their use. The contractor shall make investigation to verify the location of these facilities before proceeding with construction and/or operations in their vicinity.

1.6 CONTRACTOR'S RESPONSIBILITY FOR EVALUATION

A. The Engineer and Owner make no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground or other subsurface conditions which may be encountered during the Work. The contractor must make his own evaluation of existing conditions, which may affect methods or cost of performing the Work, based on his own examination of the facility or other information. Failure to examine the drawings or other information shall not relieve the contractor of his responsibility for satisfactory accomplishment of the Work.

B. The locations of existing services are believed to be as indicated on the plans. The contractor shall verify the location of these services prior to commencing any work and notify the Engineer of any discrepancies.

1.7 ACCESS TO FIRE PROTECTION EQUIPMENT

A. The contractor shall not interfere with access to hydrants, fire exits, fire hose stations, fire extinguishers and fire alarm pull stations. In no case shall the contractor's material or equipment be within twenty-five (25) ft of a hydrant or fire alarm pull station.

1.8 EQUIPMENT AND MATERIALS

A. If products and materials are specified or indicated on the drawings for a specific item or system, the contractor shall use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, in accordance with shop drawings.

B. All products and materials shall be new, clean, free of defects and free of damage and corrosion.

C. No permanent equipment shall be used to provide temporary services during construction.

D. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair.

E. Make certain that all materials selected directly, or by suppliers, conform to the requirements of the contract drawings and specification. Transmittal of such specifications and drawings, information to persons manufacturing and supplying materials to the project, and rigid adherence thereto, is the Contractor's responsibility. Acceptance of a manufacturer's name by the Engineer does not release the Contractor of the responsibility for providing materials, which comply in all respects with the requirements in the Contract Documents.

F. Applicable equipment and materials to be listed by Underwriters' Laboratories and Manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by local authorities having jurisdiction.

G. Fully lubricate all equipment when installed and prior to final acceptance.

H. Do not operate water systems until piping has been tested and cleaned.

I. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves. Grout all machinery set in concrete under the entire bearing surface. After grout has set, remove all wedges, shims and jack bolts and fill space with grout.

J. Locate valves, traps, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified herein.

K. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Engineer before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special valves, piping, wiring and accessories.

1.9 QUALITY ASSURANCE

A. Codes, Standards and Fees
   1. Codes and Standards:
      a. Comply with all current governing codes, ordinances and regulations, UL and all other applicable codes.
      b. Comply with the requirements of the State adopted Building Code, and other agencies or authorities having jurisdiction over any part of the Work and secure all necessary permits.
      c. Where codes or standards are listed herein, the applicable portions apply.
      d. Plans, specifications, codes and standards are all minimum requirements. Where requirements differ, apply the more stringent.
      e. Should any change in plans or specifications be required to comply with governing regulations, the contractor is to notify the Engineer at the pre-bid meeting.
      f. The codes and standards listed in the Specifications can be obtained from the organizations listed as follows:
         1) Occupational Safety and Health Act
         2) American National Standard Institute, Inc.
         3) American Society of Mechanical Engineers
         4) American Society for Testing and Materials
         5) American Water Works Association
         6) Underwriters Laboratories, Inc.
         7) American Society of Heating, Refrigerating and Air Conditioning Engineers
         8) National Electrical Manufacturers Association
         9) American Insurance Association
         10) American Welding Society
         11) American Standards Association
         12) Institute of Electrical and Electronics Engineers
         13) National Electrical Code
      g. The particular specification will be identified by appropriate prefix and number only with the latest revision being applicable unless otherwise noted.
   2. Fees
      a. Pay all required fees.
      b. Pay royalties or fees required in connection with the use of patented devices and systems.

B. Furnish all materials and equipment new, free from defects and with listings or labels of Underwriter's Laboratories, Inc. or other nationally approved testing laboratory.

C. All items of a given type shall be the product of the same manufacturer.

D. All materials and equipment shall be the product of manufacturers regularly engaged in their manufacture.

1.10 SHOP DRAWINGS

A. Prepare and submit detailed shop drawings for piping work and other distribution services, including locations and sizes of all openings in floor walls and roofs.

B. The work described in any shop drawing submission to be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with all trades on the job. Each submitted shop drawing to include a certification that all related job conditions have been checked and that no conflict exists.

C. All drawings to be submitted sufficiently in advance of field requirements to allow ample time for checking. All submittals to be complete and contain all required and detailed information. Shop drawings with multiple parts to be submitted as a package.

D. If submittals differ from the Contract Document requirements, make specific mention of such difference in a letter of transmittal, with request for substitution, together with reasons for same.

E. Review of any submitted data or shop drawings for material, equipment apparatus, devices, arrangement and layout shall not relieve the contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details to efficiently perform the requirements and intent of the Work. Such review shall not relieve the contractor from responsibility for errors, omissions or inadequacies of any sort on submitted data or shop drawings.

F. Each shop drawing is to contain the job title, the names and phone numbers of the General Contractor and the contractor, references to the applicable design drawing or specification article, date and scale.

G. Within fifteen (15) days after award of Contract, submit for review, a list of all material and equipment manufacturers whose products are proposed, as well as names of all Subcontractors whom the General Contractor proposes to employ.

H. Within three (3) weeks after award of Contract, submit a list of all shop drawings, which will be submitted in the course of the project. List to show disposition of each item, including date of submission, review, and the like. List to be kept up-to-date throughout entire construction period.

I. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents:
   1. Coordinated, detailed shop layout drawings of all mechanical rooms, services and distribution systems, including plans, profiles and sections.
   2. Details of piping supports, elbows, anchors and miscellaneous appurtenances.
   3. Hangers, supports, inserts, anchors, guides and foundations.
   4. Valves.
   5. Pressure gauges and thermometers.
   6. Corrosion protective coatings.
   7. Equipment and piping layouts at 3/8 in. scale for the building.
   8. Location and size of sleeves for openings in floors and walls.
   9. Schedule of pipe and fittings, materials and application, valves, escutcheons, air vents, valve tags and schedules, strainers, and water specialties.
   10. Building automation systems including descriptions, instruments, and alarms.

11. Flashing.
12. Equipment identification and certificates.
13. Pressure tanks and accessories.
14. Water heaters and accessories.
15. Plumbing fixture and trim.
16. Other shop drawings and submittals as requested within the specification.

1.11 SAMPLES

A. Submit samples of all items with exposed finishes for review.

B. Allow sufficient time for consideration without interfering with job schedule.

C. Duplicate quality and finish to type to be supplied under contract.

D. Identify similar to shop drawings.

1.12 START-UP

A. Properly lubricate all pieces of equipment.

B. Check and clean all pipes of dirt and debris, including strainers.

C. Prepare each piece of equipment in accordance with manufacturer's installation instructions and have a copy at the equipment.

D. Fill and vent all water systems.

E. Check rotation on each motor.

F. Have representatives of each manufacturer present when hereinafter specified, so that equipment will be started up by manufacturer.

1.13 ACCESS DOORS IN FINISHED CONSTRUCTION

A. Furnish access doors as required for operation and maintenance of concealed equipment, clean-outs, valves, shock absorbers, controls, etc., and coordinate their delivery with the installing trade.

B. Coordinate and prepare a location, size and function schedule of access doors required and deliver to the General Contractor and the Architect for review.

C. Doors shall be of a size required for operating and repacking valves, and shall be as manufactured by Karp Associates, Nystrom Inc., or Mifab.

D. Unless otherwise indicated, minimum size to be 18" x 18".

E. Furnish color coded buttons or tabs to indicate location of valves or other equipment located above removable type ceilings where access doors are not required.

F. Access doors shall have a fire rating compatible with the wall construction in which they are located.

1.14 SYSTEM IDENTIFICATION

A. Piping:
   1. All piping, exposed or concealed shall be identified as to its service in accordance with OSHA and ANSI Standards by one of the following methods:
      a. Installation of manufactured adhesive band type identification markers, similar to "Quick-Label" by W.H. Brady Company.
   2. Piping identification markings shall be installed as follows:
      a. In each room.
      b. All valve locations.
      c. At shaft walls.
      d. Every 40 feet on continuous runs.
   3. Valves:
      a. Valves shall be identified by a tag system utilizing brass tags at 2 inch minimum diameter and attached to the valves using brass chain.
         1) The new valve tag identification numbers shall be permanently added to all existing valve tag charts within the building.
   4. Equipment:
      a. Identify all controls such as motor starters not in motor control centers, float switches, and alarms.

1.15 OPERATING & MAINTENANCE INSTRUCTION

A. Prepare operating and maintenance instructions manual including operating instructions, maintenance instructions, manufacturer's data, specific equipment data.

B. Provide an alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.

C. Provide operating instructions for complete system, including:
   1. Normal starting, operating, and shut-down
   2. Emergency procedures for fire or failure of major equipment
   3. Summer and winter special procedures
   4. Day and night special procedures

D. Provide maintenance instructions, including:
   1. Valve tag list and equipment tag list
   2. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated
   3. Required cleaning, replacement and/or adjustment schedule

E. Provide manufacturer's data on each piece of equipment, including:
   1. Installation instructions.
   2. Drawings and specifications.
   3. Parts list, including recommended items to be stocked.
   4. Complete wiring and temperature control diagrams.
   5. Marked or revised prints locating all concealed parts and all variations from the original system design.
   6. Test and inspection certificates.

F. Provide specific equipment data including, but not limited to, the following:
   1. For Plumbing Systems:

a. Pumps.
b. Valves.
c. Piping.
d. Accessories.
e. Pressure reducing valves.
f. Water heaters.
g. Water meters.
h. Strainers.
i. Toilet fixtures and supports.
j. Toilet fixture trim.
k. Flow measuring devices.
l. Electric wiring.
m. Pressure tanks.

2. For Automatic Control System:
   a. Drawings and description of system controlled.
   b. Sequence of operation for each system.
   c. Data on components.
   d. Wiring and piping, schematic any layout, for panels and panelboards.
   e. System operating manual, including set points.

G. Provide instruction of operating personnel.
   1. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.
   2. Instruction to be by personnel skilled in operation of equipment. Instructions for major equipment to be by equipment manufacturers' representatives.
   3. Make arrangements to give instructions by system and not by building areas.
   4. Provide five (5) instruction sessions not to exceed six (6) hours each.
   5. Instructions on automatic controls to be by manufacturer's representative.

H. Submittals
   1. Shop Drawings: Submit three copies for review prior to final issuance.
   2. Provide six (6) copies of each operation and maintenance manual.
      a. Manuals to be 8-1/2" x 11 size in hard-back, 3-ring loose leaf binders. Use more than one volume if required. Do not overfill binders.
      b. Manuals to be completed and delivered to the Engineer for approval at least 20 days prior to instruction of operating personnel.
   3. Prepare separate manuals for the Plumbing system.

1.16 TOOLS FOR OPERATION, ADJUSTMENT AND MAINTENANCE

A. Deliver to Owner's representative all special tools needed for proper operation, adjustment and maintenance of equipment.

1.17 RECORD DRAWINGS

A. The contractor shall maintain a complete set of “Record Drawings” reflecting an accurate dimensional record of all work. These drawings shall be marked up to show the precise location of concealed work and equipment, including concealed piping and valves and all changes and deviations in the plumbing work from that shown on the contract drawings. This requirement shall not be construed as authorization for the contractor to make changes in the layout or work without written definite instruction from the Architect or Engineer.

B. Record dimensions shall clearly and accurately delineate the work as installed; location shall be suitably identified by at least two dimensions to permanent structures.

C. The contractor shall stamp all “Record Drawings” and certify for correctness by signing and dating them.

D. Record drawings submitted to Owner shall consist of 1 set of mylars and 1 set of compact disk’s (CD’s) with all work provided on Autocad 2000 format.

E. Prior to final acceptance, contractor shall submit certified “Record Drawings” to the Architect/Engineer for review and make changes, corrections or additions as noted by Architect/Engineer. After this review, the drawing shall be delivered to the Owner.

PART 2 PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Base bid on materials or equipment are specified by name of manufacturer, brand or trade name and catalog reference.

B. Refer to Division 01 Specifications for substitutions.

C. The following are base bid manufacturers for items under this Section:
1. Inserts: F and S Mfg Co., Fee and Mason and Grinnell.
2. Hangers and supports: I.T.T. Grinnell, Carpenter and Patterson, Inc., and Fee & Mason.

2.2 2.2 INSERTS AND SUPPORTS

A. Support all HVAC work from building construction by providing inserts, beam clamps, steel fishplates (in concrete fill only), and acceptable brackets. Submit all methods for review.

B. Provide trapeze hangers of bolted angles or channels for grouped lines and services.

C. Provide additional framing where building construction is inadequate. Submit for review.

D. Inserts shall be steel, slotted type and factory-painted.
1. Single rod shall be similar to Grinnell Fig. 281.
2. Multi-rod shall be similar to Fee & Mason Series 9000 with end caps and closure strips.
3. Clip form nails flush with inserts.
4. Maximum loading including pipe, contents and covering shall not exceed 75 percent of rated insert capability.

E. Supports from steel decks:
1. Pipes:
   a. Maximum size: 2-inch diameter.
   b. Hanger spacing: maximum 10-feet centers.

2.3 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:

A. Furnish supplementary steel, channels and supports required for proper installation, mounting and support of HVAC work.

B. Connect supplementary steel and channels firmly to building construction in an acceptable manner.

C. Determine type and size of supporting channels and supplementary steel. Supplementary steel and channels shall be of sufficient strength and size to allow only a minimum deflection in conformance with manufacturer's requirements of loading.

D. Install supplementary steel and channels in a neat and workmanlike manner parallel to walls, floors, and ceiling construction.

E. All supplementary steel, channels, supports shall be submitted to Structural Engineer for review.

2.4 EXPANSION ANCHORS

A. Provide smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 Type 1, Class 3.

B. Do not exceed 1/4 of average valves for a specific anchor size using 2000 psig concrete only, for maximum working load.

C. Provide spacing and install anchors in accordance with manufacturer's recommendations.

2.5 ACCESS DOORS

A. Refer to Division 08 Specifications for requirements.

2.6 ACCESS TILE IDENTIFICATION:

A. In removable ceiling tiles, provide buttons, tabs, and markers to identify location of concealed work. Submit for review.

2.7 NAMEPLATES

A. Provide nameplates with inscriptions, subject to review, indicating equipment and voltage. Fasten with epoxy cement or chrome plated screws. Nameplate shall be black Lamicoid sheet with white lettering.

B. Provide nameplates for gauges, meters, instruments, control devices, pilot lamps, transmitters, motor controllers and panel mounted equipment.

PART 3 EXECUTION

3.1 COORDINATION

A. The Contractor shall assure full cooperation of all trades and shall furnish in writing all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Prepare coordinated composite drawings at a suitable scale not less than 1/4-inch equals one foot, zero inches, clearly showing how the work of this Division is to be installed in relation to the work of all trades. Any work installed in conflict with the work of other trades shall be

corrected at no additional cost to the Owner.

3.2 THE CONTRACTOR MAY, SUBJECT TO THE ACCEPTANCE OF THE ARCHITECT AND WITHOUT EXTRA CHARGE, MAKE REASONABLE MODIFICATIONS IN THE LAYOUT AS NEEDED TO PREVENT CONFLICT WITH WORK OF ALL TRADES OR FOR THE PROPER EXECUTION OF THE WORK.

A. Plumbing Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Coordinate with the Architectural Drawings and details for exact location of ductwork, piping and equipment.

B. The Contractor shall follow Drawings in layout work and shall coordinate all trades to verify spaces in which work shall be installed. Maintain maximum headroom or space conditions. Where space conditions appear inadequate, the Architect shall be notified before installation. Do not proceed with the installation until receiving clarifying instructions.

C. Refer to Division 01 Specifications for additional requirements.

3.3 PAINTING

A. General:
1. Provide labor, materials, and equipment necessary for filed prime painting. Protect flooring and equipment with drop cloths and store paint and materials in a location where directed. Wire brush and remove all oil, dirt, rust and grease before applying paint.
2. Paint all exposed, uninsulated, non-galvanized sheet metal, other than stainless steel and aluminum, with two coats of aluminum paint or alkyd paint of a color as directed.
3. Paint all exposed, uninsulated, galvanized, aluminum and stainless steel sheet metal in finished spaces, including mechanical equipment rooms, with one coat of galvanized iron primers and two coats of alkyd oil paint.
4. Paint insulated piping and equipment covering with one coat of primer sealer and two coats of alkyd oil paint of a color as directed.
5. Factory or field apply one coat of heat resisting paint for steel pipe and finned tube radiation.
6. Paint exposed steel and metal work not furnished with factory-painted finish, structural steel piping support and uninsulated piping with two coats of alkyd oil paint of a color as directed.
7. Apply zinc chromate primer for black steel piping, cast iron piping (except underground), steel and iron work and steel tanks before insulation.
8. Dip in zinc chromate primer, uncoated hangers, supports, rods and inserts.

B. Refer to Division 09 Specifications for paint requirements.

C. Finish painting:
1. Provide finish painting for piping continuously painted in all exposed areas consisting of two finished coats of high gloss medium or long alkyd paint over prime coat of a color shade as accepted after submittal.
2. Utilize color as follows on Sherwin Williams, "Kem Lustral" or "Metalastic II" name and figure numbers.
   a. Refrigeration machines and refrigerant piping --- BRIGHT BLUE, F65L10.
   b. Supply ductwork and fans --- SILVER GRAY, B53A10.
   c. Control panels --- SLATE GRAY, B53A13.
   d. Exhaust and return ductwork and fans --- STEEL GRAY, B53A11.
   e. Fire detection and alarm conduit, fire stand pipe, sprinkler piping --- VERMILLION, F65R1.
   f. Compressed air piping and equipment --- LIGHT GRAY, F65A2.

g. Vent and relief piping --- RICH BROWN, F65N11.
h. City water --- LIGHT GREEN, F65G39.

3. Place unlisted piping, ductwork or equipment in one of the following classifications and color coded shades as accepted. This corresponds to colors of ANSI A13.1, (Scheme for identification of piping systems).
   a. Red for fire-protection materials.
   b. Yellow or Orange for dangerous materials.
   c. Green or blue for safe materials.
   d. Dark Blue or Purple for extra valuable materials.
   e. Gray for general equipment.
4. Shades shall be consistent throughout the project.
5. Coat valve, strainer or other appurtenances operating at over 220 F where bare metal is exposed with Silicone Alkyd Aluminum, 71S30.

D. Apply factory prime coat for pumps, fans, motors, equipment, registers, diffusers, and grilles.

E. Apply on machinery, one shop coat of metal primer and two finish coats of gray engine enamel.

F. Apply on control valve handles, one coat of lead and oil paint of color as selected.

G. Paint fire dampers with prime coat and second coat of corrosion inhibitive paint.

H. Spot prime coat marred surface of prime coated equipment and piping to match adjacent coat.

3.4 PIPING IDENTIFICATION

A. Stenciling:
1. Mark piping every 10 ft with size, purpose, and direction of flow and clearly stencil letters and flow arrows with flat black paint, block type letters and white background.
2. Indicate systems, size and direction of flow piping to be stenciled by Painting Contractor. Supervise stenciling and make stenciling readable from the floor of point from which ordinarily read.
3. Perform stenciling in accordance with the latest edition ANSI A13.1.

B. Pipe markers:
1. Provide factory fabricated, snap-on type pipe markers with service legend and flow arrows. The pipe markers shall be the weatherproof plastic type and shall not be used where surface temperature exceeds 180 degrees.
2. The pipe marker shall be similar to Seton Name Plate Corporation "Setmark," with the following types:
   a. Smaller than 6 in.: Setmark SNA, completely encircling pipe.
   b. 6 in and larger: Setmark STR, stainless steel spring fasteners.
3. Adhesive type markers will not be permitted.

3.5 WATERPROOFING

A. Refer to Division 07 Specifications for requirements.

B. Where any work pierces waterproofing, installation shall be subject to review, provide all necessary sleeves, caulking, flashing and flashing fittings required to make openings absolutely watertight.

3.6 FIELD QUALITY CONTROL

A. Perform tests as noted, and in the presence of Architect and/or Engineer and authorities having jurisdiction.

B. Provide required labor, material, equipment, and connections necessary for tests and submit results for review.

C. Repair or replace defective work and pay for restoring or replacing damaged work due to tests, as directed. Refer to Division 01 Specifications for additional requirements.

D. Tests and instruction: Refer to other Division 23 Specifications for requirements.
   1. Perform the following tests and inspections:
      a. Portions of testing and inspecting requirements in this article are taken from model plumbing codes. Verify requirements are applicable to location of this Project.
   2. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   3. Piping Tests:
      a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.
   4. See Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
   5. Domestic water piping will be considered defective if it does not pass tests and inspections.
   6. Prepare test and inspection reports.

3.7 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.

B. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.

C. Remove debris from inside and outside of material and equipment.

END OF SECTION

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.2 RELATED REQUIREMENTS

A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

B. Section 262913 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2018.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Operation Data: Include instructions for safe operating procedures.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.2 APPLICATIONS

A. Single phase motors for pumps: Capacitor start type.

2.3 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 220523 - General-Duty Valves for Plumbing Piping.

C. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

D. Section 220716 - Plumbing Equipment Insulation.

E. Section 220719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

A. Vertical Piping:
   1. Sleeve Length: 1 inch (25 mm) above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.

B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.2 MANUFACTURED SLEEVE-SEAL SYSTEMS

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

F. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a water-tight seal.
   6. Install in accordance with manufacturer's recommendations.

G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flow meters.

B. Pressure gauges and pressure gauge taps.

C. Thermometers and thermometer wells.

1.2 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements. for additional provisions.

1.4 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 LIQUID FLOW METERS

A. Calibrated ASME MFC-3M venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

B. Annular element flow stations with meter set.

2.2 PRESSURE GAUGES

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch (115 mm) diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi and kPa.

2.3 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).

B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).

2.4 DIAL THERMOMETERS

A. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 5 inch (125 mm) diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

B. Thermometers - Adjustable Angle: Dial type bimetallic actuated; ASTM E1; stainless steel case, adjustable angle with front recalibration, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 5 inch (125 mm) diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

C. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 230943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

D. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

E. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

F. Refer to drawings for additional required locations.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Ball valves.

D. Check valves.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083100 - Access Doors and Panels.

C. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

D. Section 220553 - Identification for Plumbing Piping and Equipment.

E. Section 220719 - Plumbing Piping Insulation.

F. Section 221005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

E. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

F. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

G. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

H. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
   5. Secure check valves in either the closed position or open position.
   6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. See drawings for specific valve locations.

B. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Dead-End: Single-flange butterfly (lug) type.

C. Domestic, Hot and Cold Water Valves:
   1. 2 NPS (50 DN) and Smaller:

a. Bronze and Brass: Provide with solder-joint ends.
b. Ball: One piece, full port, brass with brass trim.
c. Bronze Swing Check: Class 125, bronze disc.

2.2 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:

D. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.

E. General ASME Compliance:
1. Solder-joint Connections: ASME B16.18.

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port with Brass Trim:
1. Comply with MSS SP-110.
2. Body: Forged brass.
3. Ends: Threaded.
4. Seats: PTFE.
5. Stem: Brass.
6. Ball: Chrome-plated brass.

B. Two Piece, Full Port with Brass Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig (1035 kPa).
3. CWP Rating: 600 psig (4140 kPa).
4. Body: Forged brass.
5. Ends: Threaded or soldered.
6. Seats: PTFE.
7. Stem: Brass.
8. Ball: Chrome-plated brass.

2.4 BRONZE BALL VALVES

A. One Piece, Reduced Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 400 psig (2760 kPa).
3. CWP Rating: 600 psig (4140 kPa).
4. Body: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.

B. Two Piece, Standard Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig (1035 kPa).
3. CWP Rating: 600 psig (4140 kPa).

4. Body: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.

2.5 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Comply with MSS SP-80, Type 3.
   2. Design: Horizontal flow.
   3. Body: Bronze, ASTM B62.
   4. Ends: Threaded as indicated.
   5. Disc: Bronze.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.2 RELATED REQUIREMENTS

A. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 055000.

C. Metal Channel (Strut) Framing Systems:
   1. Comply with MFMA-4.
   2. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.

D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch (13 mm) diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch (6 mm) diameter.
      c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch (10 mm) diameter.

E. Pipe Supports:
   1. Liquid Temperatures Up To 122 degrees F (50 degrees C):
      a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
      b. Support From Below: MSS SP-58 Types 35 through 38.

F. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
   1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
   2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Hollow Masonry: Use toggle bolts.
   3. Hollow Stud Walls: Use toggle bolts.
   4. Steel: Use beam clamps, machine bolts, or welded threaded studs.
   5. Sheet Metal: Use sheet metal screws.
   6. Wood: Use wood screws.
   7. Plastic and lead anchors are not permitted.

H. Pipe Installation Accessories:
   1. Copper Pipe Supports:
   2. Inserts and Clamps:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Secure fasteners according to manufacturer's recommended torque settings.

H. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Tags.

C. Automatic Controls: Tags. Key to control schematic.

D. Control Panels: Nameplates.

E. Dampers: Ceiling tacks, where located above lay-in ceiling.

F. Ductwork: Nameplates.

G. Piping: Tags.

H. Small-sized Equipment: Tags.

I. Thermostats: Nameplates.

J. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.
   1. Letter Color: White.
   2. Letter Height: 1/4 inch (6 mm).
   3. Background Color: Black.
   4. Plastic: Comply with ASTM D709.

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.4 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
   2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
   3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

B. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.5 PIPE MARKERS

A. Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Color code as follows:
   1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
   2. Fire Quenching Fluids: Red with white letters.
   3. Toxic and Corrosive Fluids: Orange with black letters.
   4. Flammable Fluids: Yellow with black letters.
   5. Combustible Fluids: Brown with white letters.
   6. Compressed Air: Blue with white letters.

2.6 CEILING TACKS

A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

B. Color code as follows:
   1. Plumbing Valves: Green.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.2 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 099123.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, near major equipment items and other points of origination and termination, at access doors, above removable ceiling tiles and at each obstruction.

G. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag chart and schedule.

H. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

G. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2017, with Editorial Revision (2018).

I. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2014.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

K. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER

A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 850 degrees F (454 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

2. Vinyl emulsion type acrylic, compatible with insulation, white color.

G. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

H. Insulating Cement: ASTM C449.

2.3 CELLULAR GLASS

A. Insulation: ASTM C552, Type II, Grade 6.
1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/Pa s m) maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.

2.4 POLYETHYLENE

A. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
2. Maximum Service Temperature: 200 degrees F (93 degrees C).
3. Density: 2 lb/cu ft (32 kg/cu m).
4. Maximum Moisture Absorption: 1.0 percent by volume.
5. Moisture Vapor Permeability: 0.05 perm inch (0.073 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
6. Connection: Contact adhesive.

2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
2. Maximum Service Temperature: 220 degrees F (104 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.6 JACKETS

A. PVC Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
b. Maximum Service Temperature: 150 degrees F (66 degrees C).
c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil (0.25 mm).
e. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch (0.40 mm) sheet.

2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

A. Plumbing Systems:
1. Refer to piping schedules on drawings for insulation types, thickness and other requirements.

END OF SECTION

SECTION 221005 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Flanges, unions, and couplings.
   4. Pipe hangers and supports.
   5. Manufactured sleeve-seal systems.
   6. Ball valves.
   7. Butterfly valves.
   8. Relief valves.
   9. Strainers.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083100 - Access Doors and Panels.

C. Section 099113 - Exterior Painting.

D. Section 099123 - Interior Painting.

E. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

F. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

G. Section 220553 - Identification for Plumbing Piping and Equipment.

H. Section 220719 - Plumbing Piping Insulation.

I. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

J. Section 312316 - Excavation.

K. Section 312316.13 - Trenching.

L. Section 312323 - Fill.

M. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.3 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

D. ASME B31.9 - Building Services Piping; 2017.

E. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2019.

F. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

G. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2017.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM B32 - Standard Specification for Solder Metal; 2020.

K. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

N. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2019.

O. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

P. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

Q. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

R. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015, with Editorial Revision (2018).

S. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

T. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

U. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

V. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019.

W. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

X. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

Y. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2015.

Z. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

AA. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2016.

BB. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

CC. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2017.

DD. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2018a.

EE. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2017.

FF. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Polyethylene of Raised Temperature (PE-RT) Tubing; 2018a.

GG. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

HH. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

II. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).

JJ. AWWA C651 - Disinfecting Water Mains; 2014.

KK. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2016.

LL. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

MM. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).

NN. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

OO. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

PP. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

QQ. NSF 61 - Drinking Water System Components - Health Effects; 2019.

RR. NSF 372 - Drinking Water System Components - Lead Content; 2020.

SS. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2017.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

D. Project Record Documents: Record actual locations of valves.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Valve Repacking Kits: Two for each type and size of valve.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.
   3. Piping in Plenum Ceiling: Provide fiberglass insulation on all piping and fittings within plenum. Refer to Section 0220719 Plumbing Piping Insulation for additional requireements.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.
   3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

2.6 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High-density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
      e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
   4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
   5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.
   4. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
   5. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
   6. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Other Types: As required.

2.7 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Modular/Mechanical Seal:

1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
2. Provide watertight seal between pipe and wall/casing opening.
3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

2.8 BALL VALVES

A. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.9 PIPING SPECIALTIES

A. Flow Controls:
   1. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
   2. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.10 RELIEF VALVES

A. Pressure:
   1. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure:
   1. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F (98.9 degrees C), capacity ASME BPVC-IV certified and labelled.

2.11 STRAINERS

A. Size 1/2 Inches (15 mm) to 3 Inches (80 mm):
   1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi (1,034 kPa), 250 deg F (121.1 deg C) WOG service.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
   1. See Section 220719.

H. Provide access where valves and fittings are not exposed.
   1. Coordinate size and location of access doors with Section 083100.

I. Establish elevations of buried piping outside the building to ensure not less than 4-feet of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
   1. See Section 099123 for painting of interior plumbing systems and components.
   2. See Section 099113 for painting of exterior plumbing systems and components.

N. Excavate in accordance with Section 312316.

O. Excavate in accordance with Section 312316.13

P. Backfill in accordance with Section 312323.

Q. Backfill in accordance with Section 312316.13

R. Install bell and spigot pipe with bell end upstream.

S. Install valves with stems upright or horizontal, not inverted. See Section 220523.

T. Install water piping to ASME B31.9.

U. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

V. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

W. Sleeve pipes passing through partitions, walls, and floors.

X. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

Y. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
      a. Painting of interior plumbing systems and components is specified in Section 099123.
      b. Painting of exterior plumbing systems and components is specified in Section 099113.
   10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.
   11. Support cast iron drainage piping at every joint.

Z. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a watertight seal.
   6. Install in accordance with manufacturer's recommendations.

AA. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install globe valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring-loaded check valves on discharge of water pumps.

H. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gauge, 0.0478-inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.

3.8 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
         1) Maximum Hanger Spacing: 6.5 ft (2 m).
         2) Hanger Rod Diameter: 3/8 inches (9 mm).
      b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 3/8 inch (9 mm).
      c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 1/2 inch (13 mm).
      d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 5/8 inch (15 mm).
      e. Pipe Size: 8 inches (200 mm) to 12 inches (300 mm):
         1) Maximum hanger spacing: 14 ft (4.25 m).
         2) Hanger Rod Diameter: 7/8 inch (22 mm).
      f. Pipe Size: 14 inches and Over (350 mm and Over):
         1) Maximum Hanger Spacing: 20 ft (6 m).
         2) Hanger Rod Diameter: 1 inch (25 mm).
   2. Plastic Piping:
      a. All Sizes:
         1) Maximum Hanger Spacing: 6 ft (1.8 m).
         2) Hanger Rod Diameter: 3/8 inch (9 mm).

END OF SECTION

SECTION 221006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hydrants.

D. Backflow preventers.

E. Water hammer arrestors.

F. Mixing valves.

G. Exterior penetration accessories.

1.2 RELATED REQUIREMENTS

A. Section 011000 - Summary: Product requirements for Owner furnished kitchen equipment.

B. Section 221005 - Plumbing Piping.

C. Section 223000 - Plumbing Equipment.

D. Section 224000 - Plumbing Fixtures.

E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASME A112.6.3 - Floor and Trench Drains; 2019.

C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).

D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.

E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.

F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.

G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).

H. NEMA MG 1 - Motors and Generators; 2018.

I. NSF 61 - Drinking Water System Components - Health Effects; 2019.

J. NSF 372 - Drinking Water System Components - Lead Content; 2020.

K. PDI-WH 201 - Water Hammer Arresters; 2010.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Operation Data: Indicate frequency of treatment required for interceptors.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

G. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Loose Keys for Outside Hose Bibbs: One.
   3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

A. Floor Drains:

B. Floor Drain (FD-1):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

C. Floor Drain (FD-2):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable round nickel bronze strainer with removable perforated sediment bucket.

2.3 CLEANOUTS

A. Cleanouts at Interior Finished Floor Areas:
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

B. Cleanouts at Interior Finished Wall Areas :
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

C. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HYDRANTS

A. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type polished bronze lockable recessed box with chrome plated face, hose thread spout, handwheel, and integral vacuum breaker.

2.5 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:
   1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.6 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors:
   1. Copper construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.7 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
2. Accessories:
   a. Check valve on inlets.
   b. Volume control shut-off valve on outlet.
   c. Strainer stop checks on inlets.

2.8 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.9 EXTERIOR PENETRATION ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping, cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

END OF SECTION

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water Heaters:
   1. Commercial electric.

B. Diaphragm-type compression tanks.

1.2 RELATED REQUIREMENTS

A. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

B. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2015.

B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2019.

C. CSA P.3 - Testing Method for Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Storage Water Heaters; 2015, with Errata (2017).

D. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NEMA MG 1 - Motors and Generators; 2018.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

H. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittals procedures.

B. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Provide electrical characteristics and connection requirements.

C. Shop Drawings:
   1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

D. Project Record Documents: Record actual locations of components.

E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual locations of components.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications:
   1. Water Heaters: NSF approved.
   2. Electric Water Heaters: UL listed and labeled to UL 174.
   3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

A. Commercial Electric:

1. Type: Factory-assembled and wired, electric, vertical storage.
2. Tank: Glass lined welded steel; 4 inch (100 mm) diameter inspection port, thermally insulated with minimum 2 inches (50 mm) glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
3. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F (16 to 82 degrees C), flanged or screw-in nichrome elements, high temperature limit thermostat.
4. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
   e. Temperature and Pressure Relief Valve: ASME labeled.
5. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in (11.6 W/sq m).

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig (80 kPa).

2.3 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Domestic Water Storage Tanks:
   1. Provide steel pipe support, independent of building structural framing members.
   2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Mop sinks.

F. Under-lavatory pipe supply covers.

G. Electric water coolers.

1.2 RELATED REQUIREMENTS

A. Section 064100 - Architectural Wood Casework: Preparation of counters for sinks and lavatories.

B. Section 079200 - Joint Sealants: Sealing joints between fixtures and walls and floors.

C. Section 123600 - Countertops: Preparation of counters for sinks and lavatories.

D. Section 221005 - Plumbing Piping.

E. Section 221006 - Plumbing Piping Specialties.

F. Section 223000 - Plumbing Equipment.

G. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2017).

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2015.

E. FM (AG) - FM Approval Guide; current edition.

F. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

G. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.; 2013.

H. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

I. ASME A112.18.1 - Plumbing Supply Fittings; 2018.

J. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018.

K. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.

L. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

M. ASSE 1014 - Performance Requirements for Backflow Prevention Devices for Hand-Held Showers; 2005.

N. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2015.

O. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

P. NSF 61 - Drinking Water System Components - Health Effects; 2019.

Q. NSF 372 - Drinking Water System Components - Lead Content; 2020.

R. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.6 DESCRIPTION OF WORK

A. Provide all plumbing fixtures, fittings, trim, and accessories shown on the drawings, as required by the State and local codes, the Authority Having Jurisdiction, and as specified herein.

B. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.8 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.3 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action, china bolt caps.
   1. Bowl: ASME A112.19.2; 17 to 129 inches high with elongated rim.
   2. Flush Valve: Exposed (top spud).
   3. Flush Operation: Manual, oscillating handle.
   4. Handle Height: 44 inches (1117 mm) or less.
   5. Color: By Architect/Interior Designer.

B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.

1. Sensor-Operated Type: Solenoid operator, battery powered, infrared sensor with over-ride push button.
2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

C. Seats:
1. Solid (color by Architect/Interior Designer) plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.4 WALL HUNG URINALS

A. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
1. Flush Volume: 0.125 gallons (0.47 liters), maximum.
2. Flush Style: Washout.
3. Flush Valve: Exposed (top spud).
4. Flush Operation: Sensor operated.
5. Trap: Integral.
6. Removable stainless steel strainer.

B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
1. Sensor-Operated Type: Solenoid operator, battery powered, infrared sensor with over-ride push button.
2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.

C. Carriers:
1. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.5 LAVATORIES

A. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, with 4 inch (100 mm) high back, rectangular basin with splash lip, front overflow, and soap depression.

B. Supply Faucet Manufacturers:

C. Sensor Operated Faucet: Cast brass, chrome plated, wall mounted with sensor located on neck of spout.
1. Spout Style: Standard.
2. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
3. Mixing Valve: External lever operated.
4. Water Supply: 3/8 inch (9 mm) compression connections.
5. Aerator: Vandal resistant, 0.5 GPM (1.89 LPM), laminar flow device.
6. Finish: Polished chrome.

D. Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.

E. Provide lavatory with combination stop and strainer.

F. Accessories:
1. Carrier:
a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

2.6 SINKS

A. Double Compartment Bowl: ASME A112.19.3; _____ by _____ by _____ inch (_____ by _____ by _____ mm) outside dimensions 18 gage, _____ inch (___ mm) thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   1. Drain: 3-1/2 inch (90 mm) crumb cup and tailpiece.

2.7 UNDER-LAVATORY PIPE SUPPLY COVERS

A. General:
   1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
   2. Adhesives, sewing threads and two ply laminated materials are prohibited.
   3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
   4. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
      a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
      b. Comply with ICC A117.1.

2.8 ELECTRIC WATER COOLERS

A. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
   1. Capacity: 8 gallons per hour (30.3 liters per hour) of 50 degrees F (10 degrees C) water with inlet at 80 degrees F (27 degrees C) and room temperature of 90 degrees F (32 degrees C), when tested in accordance with ASHRAE Std 18.
   2. Electrical: 115 V, 60 Hertz compressor, 6 foot (2 m) cord and plug for connection to electric wiring system including grounding connector.

2.9 MOP SINKS

A. Material: Molded-Stone

B. Type: Rectilinear.

C. Tiling Flange Construction: Galvanized steel.

D. Grid Strainer: Stainless steel; integral; removable.

E. Dimensions: As indicated on drawings.

F. Accessories:
   1. 5 feet (1.5 m) of 1/2 inch (13 mm) diameter plain end reinforced plastic hose.
   2. Hose clamp hanger.
   3. Mop hanger.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

B. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 230001 - GENERAL PROVISION FOR HVAC WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for the following:
   1. PIPING.
   2. FAN COIL SYSTEM.
   3. PACKAGED ROOF-TOP UNITS.
   4. AIR COOLED CONDENSER SYSTEM (FOR SPLIT DX SYSTEM).
   5. SHEET METAL WORK.
   6. AIR HANDLING SYSTEM EQUIPMENT.
   7. AIR DISTRIBUTION SYSTEM EQUIPMENT.
   8. HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS.
   9. INSULATION.
   10. MOTORS.
   11. MOTOR CONTROLLERS.
   12. AUTOMATIC CONTROL SYSTEM.
   13. VIBRATION ISOLATION.
   14. NOISE CONTROL.
   15. BALANCING AIR AND WATER SYSTEMS.
   16. Refer to Division 01 Specifications for cutting and patching requirements.
   17. Provide piping from plumbing terminations, 10 ft from equipment, for water, gas, compressed air and as indicated.
   18. Provide drainage from noted equipment to floor drains, roof, sink, or funnel drains.

1.3 PERMITS AND REGULATIONS

A. Mechanical contractor and plumbing contractor shall obtain, fill-out, sign and seal permit application and will submit and pay permit costs. Contractor shall prepare specific plans as required by proper Authorities before their acceptance of the work. Each Contractor will be responsible and pay for his own fire permits, open flame permits, etc. required by Local and State Fire Regulations governing use of burning tools, etc. Contractor shall cooperate with local enforcement agency in all required or requested inspections, and will notify the Architect/Engineer of inspection schedules.

B. All work, materials, equipment and workmanship shall comply with all pertinent State, County and Municipal Laws and the requirements of such regulatory bodies as:
   1. International Mechanical Code (2015)
   2. International Fuel Gas Code (2015)
   3. International Plumbing Code (2015)
   4. National Sanitation Foundation
   5. International Building Code (2015)
   6. National Electric Code (NEC 2014)
   7. International Energy Conservation Code (2015)
   8. ASHRAE 90.1 (2013)

9. ANSI A117.1 Barrier Free Subcode
10. National Fire Protection Association (NFPA)
11. Air Conditioning and Refrigeration Institute (ARI)
12. Air Diffusion Council (ADC)
13. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
14. Associated Air Balance Council (AABC)
15. American Society of Mechanical Engineers (ASME)
16. American Society for Testing and Materials (ASTM)
17. National Electric Manufacturers Association (NEMA)
18. Underwriters Laboratories (UL)

1.4 CODES AND STANDARDS

A. Codes and Standards listed, insofar as they apply, form a part of these Specifications, the same as if they were fully written and shall be followed as minimum requirements. Where standards conflict, that standard with the more stringent requirements shall be applicable. This shall not be construed as relieving the Contractor from providing the highest grade of material and workmanship specified.

B. The Contractor shall give written notice to the Architect of any materials or apparatus believed in violation of laws, ordinances, rules or regulations, or Authorities Having Jurisdiction.

C. All equipment shall comply with all applicable requirements of laws, codes, ordinances, legislation, etc., of all Federal, State, and Local Authorities, whether or not indicated on the Contract Documents.

D. The referenced codes shall include any and all supplements, addenda, memoranda, information bulletins and any other changes and additions effective prior to the Date of Substantial Completion by adoption of the local Authority Having Jurisdiction.

E. Modifications required by the Authorities Having Jurisdiction shall be made without additional charge to the Owner.

F. Where alterations to and/or deviations from the Contract Documents are required by the Authorities, report the requirements to the Architect and secure his approval before starting the alterations.

G. Where Contract Documents' requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern.

H. All rules and regulations of the Underwriters Laboratories shall be complied with whether or not indicated in the Contract Documents. Provide Division 23 equipment having UL labels or labeled by an independent testing agency acceptable to the Authority Having Jurisdiction.

1.5 DESCRIPTION OF BID DOCUMENTS

A. Specifications, in general, describe quality and character of materials and equipment.

B. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation. Provide additional offsets, fittings, hangers, supports, valves, drains as required for construction and coordination with work of other trades.

C. Scaled and indicated dimensions are approximate and are for estimating purposes only. Before proceeding with work, check and verify all dimensions.

D. Where variances occur between the Drawings and the Specifications or within either document itself, the items or arrangement of better quality, greater quantity, or higher cost shall be included in the contract price. The Contractor shall request clarification in writing from the Architect on which item and manner in which the work shall be installed.

E. Make adjustments that may be necessary or requested in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

F. Typical details, where shown on the drawings, apply to each and every item of the project where such items are applicable. Typical details are not repeated in full on the plans, and are diagrammatic only, but with the intention that such details shall be incorporated in full.

G. If any part of Specifications or Drawings appears unclear or contradictory, consult Architect and Engineer for interpretation and decision as early as possible during bidding period. Do not proceed with work without the Architect's and/or Engineer's decision. If no consultation with Architect and/or Engineers has taken place, prior to bid submissions, contractor shall bid project to include the most expensive and/or stringent of the solutions.

1.6 DEFINITIONS

A. "Provide": to supply, install and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount and make complete with all related accessories.

C. “Furnish” or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Piping": includes pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and all related accessories.

F. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.

G. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceilings, trenches, crawl spaces, or enclosures.

H. "Exposed": in view, not installed underground or "concealed" as defined above.

I. "Indicated," "shown," or "noted": as indicated, shown or noted on drawings or specifications.

J. "Reviewed," "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by or to Architect and/or Engineer.

K. "Motor Controllers": includes manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Control or Actuating Devices": includes automatic sensing and switching devices such as thermostats, pressure, float, flow, electro-pneumatic switches and electrodes controlling operation of equipment.

1.7 QUALITY ASSURANCE

A. All equipment and accessories shall be the product of manufacturers regularly engaged in their manufacture. All items of a given type shall be the products of the same manufacturer.

B. Furnish all equipment and accessories new and free from defects.

C. All electrical equipment shall be listed by Underwriters' Laboratories, Inc. (UL) or bear UL labels.

D. Supply all equipment and accessories in complete compliance with and in accordance with the applicable standards listed in reference standards of this Section and will all applicable national, state and local codes.

1.8 JOB CONDITIONS

A. Inspection of Site Conditions:
   1. Before starting work, visit the site and examine the conditions under which the work has to be performed. Report in writing, to Architect/Engineer, any conditions which might adversely affect the work.

1.9 REFERENCE STANDARDS

A. Published specifications, standards tests, or recommended methods of trade, industry or governmental organizations apply to work in all Sections as noted below:
   1. ASHRAE - American Society of heating, Refrigerating and Air Conditioning engineers.
   2. AABC - Associated Air Balance Controls.
   3. AMCA - Air Moving and Conditioning Association.
   4. ADC - Air Diffuser Council.
   5. NEMA - National Electrical Manufacturers' Association.
   6. ANSI - American National Standards Institute.
   7. ASME - American Society of Mechanical Engineers.
   8. ASTM - American Society for Testing and Materials.
   9. NFPA - National Fire Protection Association.
   10. ARI - Air-Conditioning and Refrigeration Institute.
   11. UL - Underwriters' Laboratories, Inc.
   12. OSHA - Occupational Safety and Health Administration Regulations.

1.10 SUBMITTALS

A. Submit shop drawings product data, samples and certificates of compliance required by contract documents, "AIA Document 201" and "SUPPLEMENTARY CONDITIONS FOR MECHANICAL AND ELECTRICAL WORK." Refer to Division 01 Specifications for additional requirements.

B. Operating instructions, maintenance manuals and parts lists.
   1. Provide five sets of manufacturer's equipment brochures and service manuals consisting of the following:
      a. Descriptive literature for equipment and components.
      b. Model number and performance data.
      c. Installation and operating instructions.

d. Maintenance and repair instructions.
e. Recommended spare parts lists.

2. Assemble manufacturers' equipment manuals in chronological order following the specifications' numbering system using heavy duty three ring binders.
3. Submit valve tag chart.
4. Submit three sets of field test reports including instrument set points and normal operating valves.
5. Refer top Division 01 Specification for additional requirements.

1.11 COORDINATED COMPOSITE DRAWINGS

A. The Contractor shall prepare full coordinated composite drawings for the mechanical, electrical, plumbing and fire protection trades. The Contractor shall overlay each trade's work (in separate colors) on a set of sheetmetal drawings. All conflicts and potential conflicts shall be clearly identified on the sheetmetal drawings. This shall include but not be limited to conflicts with lights, equipment, piping, ductwork and supports of other trades, as well as conflicts with architectural and structural walls, columns, ceilings and structural beams. All trades shall resolve conflicts and sign off each sheetmetal drawing indicating acceptance and satisfactory resolution to all conflicts. All conflicts that cannot be resolved shall be brought to the attention of the Architect and Engineer.

1.12 RECORD DRAWINGS

A. The contractor shall maintain a complete set of "Record Drawings" reflecting an accurate dimensional record of all work. Refer to Division 01 Specifications for additional requirements.

1.13 CLEARANCE FROM ELECTRICAL EQUIPMENT

A. Piping and ductwork is prohibited in electric and telephone rooms and closets, elevator machine rooms, and for installations over or within 5 ft of transformers, substations, switchboards, motor control centers, standby power plants, and motors.

B. Branch piping to equipment is acceptable when installed over or within 5 ft of motors.

1.14 DRIP PANS

A. Provide drip pans under piping when installation over or within 5 ft of electrical apparatus is unavoidable or in rooms containing electrical equipment. Pan shall be reinforced, properly supported and made watertight. Provide enclosed type for pressure piping. Extend 1-1/4 in. drain pipe from pan to spill over nearest floor drain or as indicated.
1. Construction shall be 32 oz sheet copper.
2. Construction shall be 18 gauge galvanized sheet steel.

1.15 PRODUCT, DELIVERY, HANDLING AND STORAGE

A. Ship materials and equipment in crated sections of sizes to permit passing through available space, where required.

B. Receive and accept materials and equipment at the site, properly handle, house, and protect them from damage and the weather until installation. Replace equipment damaged in the course of handling without additional charge.

C. Arrange for and provide storage space or area at the job site for all materials and equipment to be received and/or installed in this project.

1.16 TEMPORARY HEAT

A. Temporary heat will be provided under General Construction Work.

1.17 ACCESSIBILITY

A. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made without written approval.

B. Group concealed valves, expansion joints, controls, dampers, and equipment requiring access, so as to be freely accessible through access doors.

1.18 SPECIAL TOOLS

A. Provide one set of any special tools required to operate, adjust, dismantle or repair equipment furnished under this Division for the Owner's use at the completion of the work.

B. Provide one pressure grease gun with adapters for each type of grease required.

C. Provide one suitable tool case for special tools.

1.19 CUTTING AND PATCHING

A. Refer to Division 01 Specifications for requirements.

1.20 UTILITY CONNECTIONS

A. Arrange for and pay costs for all specified utilities including the following:
   1. Connection to utility company mains.
   2. Payment of service charges.
   3. Provision for temporary utilities.
   4. Connect in accordance with authority having jurisdiction.

1.21 PROTECTION OF MATERIALS

A. Protect from damage, water, dust, etc., materials, equipment and apparatus provided under this trade, both in storage and installed.

PART 1 – PRODUCTS

2.1 BASE BID MANUFACTURERS

A. Base bid on materials or equipment are specified by name of manufacturer, brand or trade name and catalog reference.

B. Refer to Division 01 Specifications for substitutions.

C. The following are base bid manufacturers for items under this Section:
   1. Inserts: F and S Mfg Co., Fee and Mason and Grinnell.
   2. Hangers and supports: I.T.T. Grinnell, Carpenter and Patterson, Inc., and Fee & Mason.

2.2 INSERTS AND SUPPORTS

A. Support all HVAC work from building construction by providing inserts, beam clamps, steel fishplates (in concrete fill only), and acceptable brackets. Submit all methods for review.

B. Provide trapeze hangers of bolted angles or channels for grouped lines and services.

C. Provide additional framing where building construction is inadequate. Submit for review.

D. Inserts shall be steel, slotted type and factory-painted.
   1. Single rod shall be similar to Grinnell Fig. 281.
   2. Multi-rod shall be similar to Fee & Mason Series 9000 with end caps and closure strips.
   3. Clip form nails flush with inserts.
   4. Maximum loading including pipe, contents and covering shall not exceed 75 percent of rated insert capability.

E. Supports from steel decks:
   1. Pipes:
      a. Maximum size: 2-inch diameter.
      b. Hanger spacing: maximum 10-feet centers.
   2. Ductwork:
      a. Hangers spacing: maximum 16-feet centers.

2.3 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS:

A. Furnish supplementary steel, channels and supports required for proper installation, mounting and support of HVAC work.

B. Connect supplementary steel and channels firmly to building construction in an acceptable manner.

C. Determine type and size of supporting channels and supplementary steel. Supplementary steel and channels shall be of sufficient strength and size to allow only a minimum deflection in conformance with manufacturer's requirements of loading.

D. Install supplementary steel and channels in a neat and workmanlike manner parallel to walls, floors, and ceiling construction.

E. All supplementary steel, channels, supports shall be submitted to Structural Engineer for review.

2.4 EXPANSION ANCHORS

A. Provide smooth wall, non-self-drilling internal plug expansion type anchors constructed of AISC 12L14 steel and zinc plated in accordance with Fed. Spec. QQ-A-325 Type 1, Class 3.

B. Do not exceed 1/4 of average valves for a specific anchor size using 2000 psig concrete only, for maximum working load.

C. Provide spacing and install anchors in accordance with manufacturer's recommendations.

2.5 ACCESS DOORS

A. Refer to Division 08 Specifications for requirements.

2.6 ACCESS TILE IDENTIFICATION:

A. In removable ceiling tiles, provide buttons, tabs, and markers to identify location of concealed work. Submit for review.

2.7 NAMEPLATES

A. Provide nameplates with inscriptions, subject to review, indicating equipment and voltage. Fasten with epoxy cement or chrome plated screws. Nameplate shall be black Lamicoid sheet with white lettering.

B. Provide nameplates for gauges, meters, instruments, control devices, pilot lamps, transmitters, motor controllers and panel mounted equipment.

PART 1 - EXECUTION

3.1 COORDINATION

A. The Contractor shall assure full cooperation of all trades and shall furnish in writing all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Prepare coordinated composite drawings at a suitable scale not less than 1/4-inch equals one foot, zero inches, clearly showing how the work of this Division is to be installed in relation to the work of all trades. Any work installed in conflict with the work of other trades shall be corrected at no additional cost to the Owner.

C. The Contractor may, subject to the acceptance of the Architect and without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of all trades or for the proper execution of the work.

D. Mechanical Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Coordinate with the Architectural Drawings and details for exact location of ductwork, piping and equipment.

E. The Contractor shall follow Drawings in layout work and shall coordinate all trades to verify spaces in which work shall be installed. Maintain maximum headroom or space conditions. Where space conditions appear inadequate, the Architect shall be notified before installation.

Do not proceed with the installation until receiving clarifying instructions.

F. Refer to Division 01 Specifications for additional requirements.

3.2 PAINTING

A. General:
   1. Provide labor, materials, and equipment necessary for filed prime painting. Protect flooring and equipment with drop cloths and store paint and materials in a location where directed. Wire brush and remove all oil, dirt, rust and grease before applying paint.
   2. Paint all exposed, uninsulated, non-galvanized sheet metal, other than stainless steel and aluminum, with two coats of aluminum paint or alkyd paint of a color as directed.
   3. Paint all exposed, uninsulated, galvanized, aluminum and stainless steel sheet metal in finished spaces, including mechanical equipment rooms, with one coat of galvanized iron primers and two coats of alkyd oil paint.
   4. Paint insulated piping and equipment covering with one coat of primer sealer and two coats of alkyd oil paint of a color as directed.
   5. Factory or field apply one coat of heat resisting paint for steel pipe and finned tube radiation.
   6. Paint exposed steel and metal work not furnished with factory-painted finish, structural steel piping support and uninsulated piping with two coats of alkyd oil paint of a color as directed.
   7. Apply zinc chromate primer for black steel piping, cast iron piping (except underground), steel and iron work and steel tanks before insulation.
   8. Dip in zinc chromate primer, uncoated hangers, supports, rods and inserts.

B. Refer to Division 09 Specifications for paint requirements.

C. Finish painting:
   1. Provide finish painting for piping continuously painted in all exposed areas consisting of two finished coats of high gloss medium or long alkyd paint over prime coat of a color shade as accepted after submittal.
   2. Utilize color as follows on Sherwin Williams, "Kem Lustral" or "Metalastic II" name and figure numbers.
      a. Refrigeration machines and refrigerant piping --- BRIGHT BLUE, F65L10.
      b. Supply ductwork and fans --- SILVER GRAY, B53A10.
      c. Control panels --- SLATE GRAY, B53A13.
      d. Exhaust and return ductwork and fans --- STEEL GRAY, B53A11.
      e. Fire detection and alarm conduit, fire stand pipe, sprinkler piping --- VERMILLION, F65R1.
      f. Compressed air piping and equipment --- LIGHT GRAY, F65A2.
      g. Vent and relief piping --- RICH BROWN, F65N11.
      h. City water --- LIGHT GREEN, F65G39.
   3. Place unlisted piping, ductwork or equipment in one of the following classifications and color coded shades as accepted. This corresponds to colors of ANSI A13.1, (Scheme for identification of piping systems).
      a. Red for fire-protection materials.
      b. Yellow or Orange for dangerous materials.
      c. Green or blue for safe materials.
      d. Dark Blue or Purple for extra valuable materials.
      e. Gray for general equipment.
   4. Shades shall be consistent throughout the project.
   5. Coat valve, strainer or other appurtenances operating at over 220 o F where bare metal is exposed with Silicone Alkyd Aluminum, 71S30.

D. Paint interior of ductwork as far back as visible from outside, flat black.

E. Apply factory prime coat for pumps, fans, motors, equipment, registers, diffusers, and grilles.

F. Apply on machinery, one shop coat of metal primer and two finish coats of gray engine enamel.

G. Apply on control valve handles, one coat of lead and oil paint of color as selected.

H. Paint fire dampers with prime coat and second coat of corrosion inhibitive paint.

I. Spot prime coat marred surface of prime coated equipment and piping to match adjacent coat.

3.3 PIPING IDENTIFICATION

A. Stenciling:
   1. Mark piping every 10 ft with size, purpose, and direction of flow and clearly stencil letters and flow arrows with flat black paint, block type letters and white background.
      a. Outside Dia. of Pipe Covering Size of Stencil 3/4 in. - 1-1/4 in. 1/2 in. 1-1/2 in. - 2 in. 3/4 in. 2-1/2 in. - 6 in. 1-1/4 in. 8 in. - 10 in. 2-1/2 in. over 10 in. 3-1/2 in.
   2. Indicate systems, size and direction of flow piping to be stenciled by Painting Contractor. Supervise stenciling and make stenciling readable from the floor of point from which ordinarily read.
   3. Perform stenciling in accordance with the latest edition ANSI A13.1.

B. Pipe markers:
   1. Provide factory fabricated, snap-on type pipe markers with service legend and flow arrows. The pipe markers shall be the weatherproof plastic type and shall not be used where surface temperature exceeds 180 degrees.
   2. The pipe marker shall be similar to Seton Name Plate Corporation "Setmark," with the following types:
      a. Smaller than 6 in.: Setmark SNA, completely encircling pipe.
      b. and larger: Setmark STR, stainless steel spring fasteners.
   3. Adhesive type markers will not be permitted.

3.4 WATERPROOFING

A. Refer to Division 07 Specifications for requirements.

B. Where any work pierces waterproofing, installation shall be subject to review, provide all necessary sleeves, caulking, flashing and flashing fittings required to make openings absolutely watertight.

3.5 FIELD QUALITY CONTROL

A. Perform tests as noted, and in the presence of Architect and/or Engineer and authorities having jurisdiction.

B. Provide required labor, material, equipment, and connections necessary for tests and submit results for review.

C. Repair or replace defective work and pay for restoring or replacing damaged work due to tests, as directed. Refer to Division 01 Specifications for additional requirements.

D. Tests and instruction: Refer to other Division 23 Specifications for requirements.

3.6 CLEANING

A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.

B. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.

C. Remove debris from inside and outside of material and equipment.

END OF SECTION

SECTION 230130.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of HVAC duct system, equipment, and related components.

1.2 RELATED REQUIREMENTS

1.3 DEFINITIONS

A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.4 REFERENCE STANDARDS

1.5 QUALITY ASSURANCE

A. Information Available to Contractor: Upon request, Owner will provide the following:
   1. One copy of original construction drawings of HVAC system.

B. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
   1. Certified by one of the following:
      a. NADCA, National Air Duct Cleaners Association: www.nadca.com
   2. Having minimum of three years documented experience.
   3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

C. Testing and Inspection Agency Qualifications: Experienced in inspection and testing using methods defined in NADCA ACR.

PART 2 PRODUCTS

2.1 TOOLS AND EQUIPMENT

A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.

B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.

C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris

removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

A. Comply with applicable federal, state, and local requirements.

B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.

C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.

D. Obtain Owner's approval of proposed temporary locations for large equipment.

E. Designate a decontamination area and obtain Owner's approval.

F. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

3.2 EXAMINATION

A. Prior to the commencement of any cleaning work, prepare and submit to Architect a project evaluation and plan for this project, including considerations recommended in NADCA ACR.

B. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.

C. Start of cleaning work constitutes acceptance of existing conditions.

D. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.

E. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.3 PREPARATION

A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.

B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.

C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.

D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
   1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
   2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
   3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.

E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.4 CLEANING

A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.

B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.

C. Ducts: Mechanically clean all portions of ducts.

D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.

E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.

F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.

G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.

H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.5 REPAIR

A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.

B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.

C. Reseal new openings in accordance with NADCA Standard 05.

D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.

E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.6 FIELD QUALITY CONTROL

A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.

B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.

C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.

D. Notify Architect when cleaned components are ready for inspection.

E. When directed, re-clean components until they pass.

F. Contractor shall bear the costs of retesting due to inadequate cleaning.

G. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.7 ADJUSTING

A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.8 WASTE MANAGEMENT

A. Double-bag waste and debris in 6 mil, 0.006 inch (0.1524 mm) thick polyethylene plastic bags.

B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.2 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2018.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.2 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Motors located in exterior locations and air cooled condensers: Totally enclosed type.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 230716 - HVAC Equipment Insulation.

C. Section 230719 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience.
   2. Approved by manufacturer.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.7 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

A. Manufacturers:
   1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Vertical Piping:
   1. Sleeve Length: 1 inch (25 mm) above finished floor.
   2. Provide sealant for watertight joint.
   3. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.

C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

E. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.2 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
   2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.

3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations:
1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
2. Aboveground Piping:
   a. Pack solid using mineral fiber in compliance with ASTM C592.
   b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 230548 - Vibration and Seismic Controls for HVAC.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

F. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

G. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

J. MFMA-4 - Metal Framing Standards Publication; 2004.

K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

L. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Installer's Qualifications: Include evidence of compliance with specified requirements.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Installer Qualifications for Field-Welding: As specified in Section 055000.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Materials for Metal Fabricated Supports: Comply with Section 055000.

C. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   2. Comply with MFMA-4.
   3. Channel Material:
      a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
   4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm).
   5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.

D. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Channel Material: Use polyester resin or vinyl ester resin.
   2. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
   1. Minimum Size, Unless Otherwise Indicated or Required:
      a. Equipment Supports: 1/2 inch (13 mm) diameter.
      b. Piping up to 1 inch (27 mm) nominal: 1/4 inch (6 mm) diameter.

c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch (10 mm) diameter.
d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.

F. Steel Cable:

G. Thermal Insulated Pipe Supports:
1. General Construction and Requirements:
a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch (12.7 mm to 762 mm) iron pipes.
d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
b. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
c. Maximum Service Temperature: 180 degrees F (82 degrees C).
d. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
e. Thickness: 60 mil (1.524 mm).
f. Connections: Brush on welding adhesive.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

H. Pipe Supports:
1. Liquid Temperatures Up To 122 degrees F (50 degrees C):
a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
b. Support From Below: MSS SP-58 Types 35 through 38.

I. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.
1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

J. Riser Clamps:
1. Provide copper plated clamps for copper tubing support.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.

K. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

L. Strut Clamps: Two-piece pipe clamp.

M. Insulation Clamps: Two bolt-type clamps designed for installation under insulation.

N. Pipe Hangers: For a given pipe run use hangers of the same type and material.
1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

O. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
1. Pipe Diameter 6 inches (150 mm) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).

2. Pipe Diameter 8 inches (200 mm): Provide U-bolts with double nuts providing minimum clearance of 0.28 inch (7 mm).
3. Pipe Diameter 8 inches (200 mm): 0.625 inch (16 mm) U-bolt.
4. Pipe Diameter 10 inches (250 mm): 0.75 inch (19 mm) U-bolt.

P. Pipe Alignment Guides: Galvanized steel.
1. Pipe Diameter 8 inches (200 mm) and Smaller: Spider or sleeve type.
2. Pipe Diameter 10 inches (250 mm) and Larger: Roller type.

Q. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

R. Non-Penetrating Rooftop Supports for Low-Slope Roofs:
1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
4. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

S. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
3. Steel: Use beam clamps, machine bolts, or welded threaded studs.
4. Sheet Metal: Use sheet metal screws.
5. Wood: Use wood screws.
6. Plastic and lead anchors are not permitted.
7. Powder-actuated fasteners are not permitted.
8. Hammer-driven anchors and fasteners are not permitted.
9. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
   a. Comply with MFMA-4.
   b. Channel Material: Use galvanized steel.
   c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch (2.66 mm) minimum base metal thickness.
   d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
10. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

T. Pipe Installation Accessories:
1. Thermal Insulated Pipe Supports:
2. Overhead Pipe Supports:
3. Plenum Pipe Supports:
4. Inserts and Clamps:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Field-Welding (where approved by Architect): Comply with Section 055000.

H. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

I. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 033000.
   5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

J. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

K. Secure fasteners according to manufacturer's recommended torque settings.

L. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

D. Vibration-isolated and/or seismically engineered roof curbs.

1.2 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections and Procedures.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 210548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.

E. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

F. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

1.3 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2002.

D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.

E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.

F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities.

D. Shop Drawings - Vibration Isolation Systems:
   1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Evidence of qualifications for manufacturer.

G. Manufacturer’s detailed field testing and inspection procedures.

H. Field quality control test reports.

1.7 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
3. Select vibration isolators for outdoor equipment to comply with wind design requirements.
4. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch (50 mm) operating clearance beneath base unless otherwise indicated.

D. Equipment Isolation: As indicated on drawings.

E. Piping Isolation:
1. Provide vibration isolators for piping supports:
   a. Located in equipment rooms.
   b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
   c. For piping over 2 inch (50 mm) located below or within 50 feet (15.2 m) of noise-sensitive areas indicated.
2. Minimum Static Deflection:
   a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
   b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
3. Suspended Piping, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Floor-Mounted Piping, Non-Seismic Applications: Use open (unhoused) spring isolators.

5. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g. walls, floors) arranged to prevent vibration transmission to structure.

F. Thrust Restraint Applications:
   1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg (0.5 kPa) or greater total static pressure.
   2. Minimum Static Deflection: Same as static deflection of equipment.
   3. Limit lateral movement to 0.25 inch (6 mm) or less unless otherwise indicated.

2.2 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Vibration-Isolated Structural Steel Bases:
   1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

B. Vibration-Isolated Concrete Inertia Bases:
   1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Minimum Base Depth: 6 inches (152 mm).
   3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
   4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
   5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 033000.
   6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

2.3 VIBRATION ISOLATORS

A. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.

B. Vibration Isolators for Non-Seismic Applications:
   1. Resilient Material Isolator Pads:
      a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material.
      b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
      c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
   2. Resilient Material Isolator Mounts, Non-Seismic:
      a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe

type.

3. Open (Unhoused) Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
   b. Bottom Load Plate: Non-skid molded elastomeric isolator material or steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
   b. Furnished with integral elastomeric snubbing elements, non-adjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
   c. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Non-Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
   b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
9. Thrust Restraints:
   a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g. air pressure from a fan), and intended for installation in pairs.

2.4 ACOUSTICAL AND VIBRATION ISOLATORS

A. General Requirements:
   1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.5 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Vibration Isolation Curbs:
   1. Non-Seismic Curb Rail:
      a. Location: Between existing roof curb and rooftop equipment.
      b. Construction: Aluminum.
      c. Integral vibration isolation to comply with requirements of this section.
      d. Weather exposed components consist of corrosion resistant materials.
   2. Non-Seismic Curb:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Aluminum.
      c. Integral vibration isolation to comply with requirements of this section.
      d. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
   1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Field-Welding (where approved by Architect): Comply with Section 055000.

E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

F. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   3. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
      b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
   4. Thrust Restraints:
      a. Adjust restraint movement under normal operating static pressure.
   5. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
   6. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
   7. Adjust isolators to be free of isolation short circuits during normal operation.
   8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify required clearance beneath vibration-isolated equipment support bases.
   3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.5 ATTACHMENTS

A. Statement of special inspections.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Adhesive-backed duct markers.

D. Stencils.

E. Pipe markers.

F. Ceiling tacks.

1.2 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

C. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Automatic Controls: Tags. Key to control schematic.

C. Control Panels: Nameplates.

D. Dampers: Ceiling tacks, where located above lay-in ceiling.

E. Ductwork: Nameplates.

F. Heat Transfer Equipment: Nameplates.

G. Major Control Components: Nameplates.

H. Piping: Tags.

I. Small-sized Equipment: Tags.

J. Thermostats: Nameplates.

2.2 NAMEPLATES

A. Letter Color: White.

B. Letter Height: 1/4 inch (6 mm).

C. Background Color: Black.

D. Plastic: Comply with ASTM D709.

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.4 ADHESIVE-BACKED DUCT MARKERS

A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.

B. Style: Individual Label.

C. Color: Yellow/Black.

2.5 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
   2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
   3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
   4. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.

B. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.6 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Color code as follows:
   1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

2.7 CEILING TACKS

A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 099123.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
6. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

G. Install duct markers with permanent adhesive on air ducts in the following color codes:
1. Green: For supply ducts
2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
4. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

H. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

I. Locate duct markers or nameplates near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

J. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

K. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

1.2 RELATED REQUIREMENTS

A. Section 014000 - Quality Requirements: Employment of testing agency and payment for services.

1.3 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods; 2016, with Errata.

C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

D. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems; 2019.

E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   2. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   3. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

c. Identification and types of measurement instruments to be used and their most recent calibration date.
d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
e. Final test report forms to be used.
f. Expected problems and solutions, etc.
g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
h. Details of how TOTAL flow will be determined; for example:
    1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
l. Method of checking building static and exhaust fan and/or relief damper capacity.
m. Time schedule for deferred or seasonal TAB work, if specified.
n. False loading of systems to complete TAB work, if specified.
o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
q. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least twice a week to the Commissioning Authority.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit under provisions of Section 014000.
2. Revise TAB plan to reflect actual procedures and submit as part of final report.
3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.
7. Include the following on the title page of each report:
    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Address of Testing, Adjusting, and Balancing Agency.
    c. Telephone number of Testing, Adjusting, and Balancing Agency.
    d. Project name.
    e. Project location.
    f. Project altitude.
    g. Report date.

G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
   3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   4. Duct systems are clean of debris.
   5. Fans are rotating correctly.
   6. Fire and volume dampers are in place and open.
   7. Air coil fins are cleaned and combed.
   8. Access doors are closed and duct end caps are in place.
   9. Air outlets are installed and connected.
   10. Duct system leakage is minimized.
   11. Hydronic systems are flushed, filled, and vented.
   12. Pumps are rotating correctly.
   13. Proper strainer baskets are clean and in place.
   14. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   3. Contract interpretation requests.
   4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

3.6 WATER SYSTEM PROCEDURE

3.7 SCOPE

A. Test, adjust, and balance the following:
   1. Forced Air Furnaces.
   2. Air Cooled Refrigerant Condensers.
   3. Packaged Roof Top Heating/Cooling Units.
   4. Computer Room Air Conditioning Units.
   5. Air Coils.
   6. Sprayed Coil Dehumidifier.
   7. Air Handling Units.
   8. Fans.
   9. Air Filters.
   10. Air Terminal Units.
   11. Air Inlets and Outlets.

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.

3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:
1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Combustion Equipment:
1. Gas flow rate.
2. Heat input.
3. Burner manifold gas pressure.

D. Air Cooled Condensers:
1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Entering DB air temperature, design and actual.
7. Leaving DB air temperature, design and actual.
8. Number of compressors.

E. Cooling Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Entering air DB temperature, design and actual.
7. Entering air WB temperature, design and actual.
8. Leaving air DB temperature, design and actual.
9. Leaving air WB temperature, design and actual.
10. Saturated suction temperature, design and actual.
11. Air pressure drop, design and actual.

F. Heating Coils:
1. Location.
2. Service.
3. Manufacturer.
4. Air flow, design and actual.
5. Entering air temperature, design and actual.
6. Leaving air temperature, design and actual.
7. Air pressure drop, design and actual.

G. Electric Duct Heaters:
1. Identification/number.
2. Location.
3. Model number.
4. Design kW.

5. Number of stages.
6. Phase, voltage, amperage.
7. Test voltage (each phase).
8. Test amperage (each phase).
9. Air flow, specified and actual.
10. Temperature rise, specified and actual.

H. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

I. Return Air/Outside Air:
1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

J. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

K. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.

6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

L. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus:
   a. Blower.
   b. Orifice, tube size.
   c. Orifice size.
   d. Calibrated.
7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

M. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.

END OF SECTION

SECTION 230713 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

1.2 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 078400 - Firestopping.

C. Section 099113 - Exterior Painting: Painting insulation jackets.

D. Section 099123 - Interior Painting: Painting insulation jackets.

E. Section 230553 - Identification for HVAC Piping and Equipment.

F. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.3 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

C. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2014.

D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

F. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017 (Reapproved 2023).

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. CertainTeed Corporation
   2. Johns Manville
   3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K (Ksi) value: 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 1200 degrees F (649 degrees C).
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter (1.29 mm diameter).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ducts conveying air above ambient temperature:
   1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor) ((below 3 meters above finished floor)): Finish with canvas jacket sized for finish painting.

E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
   3. Seal and smooth joints. Seal and coat transverse joints.
   4. Seal liner surface penetrations with adhesive.
   5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Supply and Outside Air Intake Ducts, and Plenums:
   1. Flexible Glass Fiber Duct Insulation: 1" thick.
   2. Rigid Glass Fiber Duct Insulation: 1-1/2" thick..
   3. Rigid Glass Fiber Duct Liner Insulation: 1-1/2" thick where indicated on drawings.

B. Supply, Return and Outside Air Intake Ducts, and Plenums located in unconditioned spaces:
   1. Flexible Glass Fiber Duct Insulation: 2-1/2" thick or minimum R-6 (installed).
   2. Rigid Glass Fiber Duct Insulation: 1-1/2" thick or minimum R-6 (installed).
   3. Rigid Glass Fiber Duct Liner Insulation: 1-1/2" thick where indicated on drawings.

C. Supply, Return, Exhaust, and Outside Air Ducts and Plenums Exposed to Outdoors:
   1. Rigid Glass Fiber Duct Insulation in Climate Zone 4: 2" thick with aluminum jacket.
   2. Rigid Glass Fiber Duct Liner Insulation in Climate Zone 4: 2" thick where indicated on drawings.

D. Supply, Return, Exhaust, and Outside Air Ducts and Plenums above insulated ceilings or located in attics:
   1. Flexible Glass Fiber Duct Insulation: 2-1/2" thick or minimum R-6 (installed).
   2. Rigid Glass Fiber Duct Insulation: 1-1/2" thick or minimum R-6 (installed).
   3. Rigid Glass Fiber Duct Liner Insulation: 1-1/2" thick where indicated on drawings.

END OF SECTION

SECTION 230719 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jackets and accessories.

D. Engineered wall outlet seals and refrigerant piping insulation protection.

1.2 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 078400 - Firestopping.

C. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 232300 - Refrigerant Piping: Placement of inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

I. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2017, with Editorial Revision (2018).

J. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).

K. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

L. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).

M. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2014.

N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

O. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

P. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

R. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021.

S. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

T. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.

U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation.
   2. Johns Manville Corporation.
   3. Knauf Insulation.
   4. Owens Corning Corporation.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 850 degrees F (454 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
   2. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
   3. Weave: 5 by 5.

H. Indoor Vapor Barrier Finish:
   1. Vinyl emulsion type acrylic, compatible with insulation, black color.

I. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Insulating Cement: ASTM C449.

2.3 POLYETHYLENE

A. Manufacturers:
   1. Armacell LLC
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
   1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
   2. Maximum Service Temperature: 300 degrees F (150 degrees C).
   3. Density: 2 lb/cu ft (32 kg/cu m).
   4. Maximum Moisture Absorption: 1.0 percent by volume.
   5. Moisture Vapor Permeability: 0.05 perm inch (0.073 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
   6. Connection: Contact adhesive.

2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; Aerocel ULP
   2. Armacell LLC; AP Armaflex
   3. K-Flex USA LLC; K-Flex Titan

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
   1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
   2. Maximum Service Temperature: 180 degrees F (82 degrees C).
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.5 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
      b. Maximum Service Temperature: 150 degrees F (66 degrees C).
      c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil (0.25 mm).
      e. Connections: Brush on welding adhesive.
   3. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch (0.40 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.

4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

2.6 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

A. Manufacturers:
1. Airex Manufacturing, Inc; ____: www.airexmfg.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
1. Pipe Penetration Wall Seal: Airex Titan Outlet.
2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.

C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Outlet Cover Color: Gray.
2. Water Penetration: Comply with ASTM E331.
3. Air Leakage: Comply with ASTM E283.
4. Air Permeance: Comply with ASTM E2178.

D. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
6. Carbon Arc Light Exposure: Comply with ASTM G153.
7. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.
8. Water Absorption of Plastics: Comply with ASTM D570.
9. Adhesive free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

E. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.

F. Inserts and Shields:
   1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.

I. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

J. INTERIOR INSULATION APPLICATION SCHEDULE
   1. Service: Condensate drain piping.
      a. Operating Temperature: 35 to 75 deg F.
      b. Insulation Material: Flexible elastomeric.
      c. Insulation Thickness: 1”.
      d. Field-Applied Jacket: None.
      e. Vapor Retarder Required: Yes.
      f. Finish: None.
   2. Service: Refrigerant suction and hot-gas piping.
      a. Operating Temperature: 35 to 50 deg F.
      b. Insulation Material: Flexible Elastomeric.
      c. Insulation Thickness: Apply the following insulation thicknesses:
      d. Insert additional subparagraphs below if more size ranges are required. Select or insert pipe material to suit Project.
      e. Steel or Copper Pipe, Up to 4” diameter: 1” INSULATION THICKNESS
      f. Field-Applied Jacket: None.
      g. Vapor Retarder Required: No.
      h. Finish: None.

K. EXTERIOR INSULATION APPLICATION SCHEDULE (ABOVEGROUND OUTSIDE OF BUILDING)
   1. Service: Refrigerant suction.
      a. Operating Temperature: 35 to 50 deg F.
      b. Insulation Material: Flexible elastomeric.
      c. Insulation Thickness: Apply the following insulation thicknesses:
      d. Insert additional subparagraphs below if more size ranges are required. Select or insert pipe material to suit Project.
      e. Steel or Copper Pipe, Up to 4” diameter: 2” INSULATION THICKNESS
      f. Field-Applied Jacket: None.

g. Vapor Retarder Required: Yes.
h. Finish: None.

3.3 SCHEDULE

A. Cooling Systems:
1. Insulation for Condensate Drains from Cooling Coils:
a. Less than 1-1/2" thick: 1-1/2" thick fiberglass insulation with PVC covered fittings. Provide jacketing on piping installed at exterior.
2. Refrigerant Suction and Hot Gas:
a. Less than 1-1/2" : 1" foam. Provide jacketing on piping installed at exterior.

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensate drain piping (cooling and heating), above grade.

B. Pipe hangers and supports.

C. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083100 - Access Doors and Panels.

C. Section 099123 - Interior Painting.

D. Section 230516 - Expansion Fittings and Loops for HVAC Piping.

E. Section 230523 - General-Duty Valves for HVAC Piping.

F. Section 230548 - Vibration and Seismic Controls for HVAC.

G. Section 230553 - Identification for HVAC Piping and Equipment.

H. Section 230719 - HVAC Piping Insulation.

I. Section 232114 - Hydronic Specialties.

J. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2024.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

F. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

G. ASME B31.9 - Building Services Piping; 2017.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

K. ASTM B32 - Standard Specification for Solder Metal; 2020.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

N. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.

O. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.

P. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

Q. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

R. AWWA C606 - Grooved and Shouldered Joints; 2015.

S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalogue information.
   3. Indicate valve data and ratings.
   4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of valves.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Valve Repacking Kits: One for each type and size of valve.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with documented experience.

C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

E. Coupling Manufacturer:
   1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
   2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
   3. A distributor's representative is not considered qualified to perform the training.

F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 CONDENSATE DRAIN PIPING (COOLING AND HEATING), ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
   a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
   a. Manufacturers:
      1) Apollo Valves; _____: www.apollovalves.com/#sle.
      2) Grinnell Products; _____: www.grinnell.com/#sle.
      3) Viega LLC; _____: www.viega.us/#sle.
      4) Substitutions: See Section 016000 - Product Requirements.

2.2 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.
   6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
   9. Vertical Support: Steel riser clamp.
   10. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   11. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   13. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   14. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.3 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches (50 mm) and Less:
   1. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches (50 mm) and Greater:
   1. Copper Piping: Bronze.
   2. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
   4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
   6. Manufacturers:
      a. Apollo Valves; _____: www.apollovalves.com/#sle.
      b. Grinnell Products; _____: www.grinnell.com/#sle.
      c. Shurjoint Piping Products, Inc; _____: www.shurjoint.com/#sle.
      d. Victaulic Company; _____: www.victaulic.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

D. Dielectric Connections:
   1. Waterways:
      a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      b. Dry insulation barrier able to withstand 600 volt breakdown test.
      c. Construct of galvanized steel with threaded end connections to match connecting piping.
      d. Suitable for the required operating pressures and temperatures.
   2. Flanges:
      a. Dielectric flanges with same pressure ratings as standard flanges.
      b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      c. Dry insulation barrier able to withstand 600 volt breakdown test.
      d. Construct of galvanized steel with threaded end connections to match connecting piping.
      e. Suitable for the required operating pressures and temperatures.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 232500 for additional requirements.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 230516.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.

J. Grooved Joints:
   1. Install in accordance with the manufacturer's latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

K. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

L. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   5. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.
   9. Prime coat exposed steel hangers and supports. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 230719.

N. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 083100 .

O. Use eccentric reducers to maintain top of pipe level.

P. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

Q. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 099123.

R. Install valves with stems upright or horizontal, not inverted.

3.3 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
   2. 1 inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
   3. 1-1/2 inch (40 mm) and 2 inch (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
   4. 2-1/2 inch (65 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
   5. 3 inch (80 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Filter-driers.

G. Engineered wall seals and insulation protection.

H. Exterior penetration accessories.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083100 - Access Doors and Panels.

C. Section 099123 - Interior Painting.

D. Section 230719 - HVAC Piping Insulation.

E. Section 236313 - Air Cooled Refrigerant Condensers.

F. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; 2005.

B. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

C. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers; 2013 (Reapproved 2014).

D. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.

E. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.

F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2016, with Addendum (2017).

G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2019.

H. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

I. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

J. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.

K. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2020.

L. ASME B31.9 - Building Services Piping; 2017.

M. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

P. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2019.

Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).

R. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

S. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021.

T. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

U. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

V. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.

W. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

X. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

Y. ICC (IMC)-2018 - International Mechanical Code; 2018.

Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Filter-Driers:
   1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

D. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Submit welders certification of compliance with ASME BPVC-IX.

H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Filter-Dryer Cartridges: One of each type and size.
   3. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Comply with ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME BPVC-IX.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

2.2 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
   1. Fittings: ASME B16.22 wrought copper.
   2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

B. Copper Tube to 7/8 inch (22 mm) OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
   1. Fittings: ASME B16.26 cast copper.
   2. Joints: Flared.

C. Pipe Supports and Anchors:
   1. Provide hangers and supports that comply with MSS SP-58.
      a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
   6. Vertical Support: Steel riser clamp.
   7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
   10. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 REFRIGERANT

A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

B. Refrigerant: R-134a, tetrafluoroethane as defined in ASHRAE Std 34.

2.4 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.5 ENGINEERED WALL SEALS AND INSULATION PROTECTION

A. Manufacturers:
   1. Airex Manufacturing, Inc; ____: www.airexmfg.com/#sle.

B. Basis of Design: Airex Manufacturing, Inc; www.airexmfg.com/#sle.
   1. Pipe Penetration Wall Seal: Airex Titan Outlet.
   2. Refrigeration Pipe Insulation Protection System: Airex E-Flex Guard.
   3. Pipe Penetration Wall Seal and Insulation Protection System: Airex Pro-System Kit.

C. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
   1. Outlet Cover Color: Gray.
   2. Water Penetration: Comply with ASTM E331.
   3. Air Leakage: Comply with ASTM E283.
   4. Air Permeance: Comply with ASTM E2178.

D. Insulation Protection System: Mechanical line insulation and PVC cover.
   1. PVC Insulation Cover Color: Black with full-length velcro fastener.
   2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
   3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
   4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
   5. Flame Spread and Smoke Development Rating of 25/450: Comply with ASTM E84.
   6. Adhesive free.

2.6 EXTERIOR PENETRATION ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.5.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 083100.

K. Flood piping system with nitrogen when brazing.

L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 099123.

N. Insulate piping and equipment; refer to Section and Section 230716.

O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

R. Fully charge completed system with refrigerant after testing.

S. Provide electrical connection to solenoid valves. Refer to Section 260583.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Test refrigeration system in accordance with ASME B31.5.

C. Pressure test system with dry nitrogen to 200 psi (1380 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psi (1380 kPa) using halide torch. Test to no leakage.

3.4 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
   2. 1-1/8 inch (29 mm) OD: Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6.3 mm).
   3. 1-3/8 inch (35 mm) OD: Maximum span, 7 feet (2100 mm); minimum rod size, 3/8 inch (9.5 mm).
   4. 1-5/8 inch (41 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   5. 2-1/8 inch (54 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

END OF SECTION

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casings and plenums.

D. Duct cleaning.

1.2 RELATED REQUIREMENTS

A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 078400 - Firestopping.

C. Section 099113 - Exterior Painting: Weld priming, weather resistant, paint or coating.

D. Section 099123 - Interior Painting: Weld priming, paint or coating.

E. Section 230130.51 - HVAC Air-Distribution System Cleaning: Cleaning ducts after completion of installation.

F. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

G. Section 230713 - Duct Insulation: External insulation and duct liner.

H. Section 233300 - Air Duct Accessories.

I. Section 233700 - Air Outlets and Inlets.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2016.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.

E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

I. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

K. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

L. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

M. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

N. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

O. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

P. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

Q. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

R. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

S. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

D. Sheet Metal Shop Drawings: After coordination with trades, prepare CAD-generated drawings at minimum 3/8 inch equals 1 foot scale. Show fabrication and installation details for metal ducts.
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Reflected ceiling plans, room names and numbers.
   4. Major building and structural elements.

5. Major equipment and piping for Mechanical Rooms.
6. Elevations of top and bottom of ducts.
7. Dimensions of main duct runs from building grid lines.
8. Elevation views, locating dimensions from column lines or other references.
9. Duct acoustical lining or external insulation.
10. Fittings.
11. Reinforcement and spacing.
12. Seam and joint construction.
13. Penetrations through fire-rated and other partitions.
14. Equipment installation based on equipment being used on Project.
15. Duct accessories, including access doors and duct-mounted equipment such as fire, smoke, automatic control and balancing dampers, sound attenuators, humidifiers, airflow measuring stations, airflow control valves, smoke detectors and fans.
16. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
17. Interferences between ductwork and piping, lights, structure or any specialty systems.

E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Other systems installed in same space as ducts incluing piping, conduit, cable, support trays and other specialty systems.
   3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
   4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

F. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

G. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

C. All ductwork shall be free from pulsation, chatter and vibration. If any of these defects appear after a system is in operation, correct by removing and replacing, or reinforcing the ductwork at no additional cost to the Owner.

D. Close the open ends of ducts during construction to prevent dirt and debris from entering.

E. Touch-up all welded and scratched galvanized steel surfaces with zinc-rich paint.

F. Duct leakage testing shall be performed under Division 23 and documented using SMACNA or other approved protocols.

1.6 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply and Outside Air (Heating Systems): 2 inch w.g. (500 Pa) pressure class, galvanized steel.

D. Low Pressure Supply and Outside Air (System with Cooling Coils): 2 inch w.g. (500 Pa) pressure class, galvanized steel.

E. Return and Relief: 1 inch w.g. (250 Pa) pressure class, galvanized steel.

F. General Exhaust: 1 inch w.g. (250 Pa) pressure class, galvanized steel.

G. Outside Air Intake: 1 inch w.g. (250 Pa) pressure class, galvanized steel.

H. Transfer Air and Sound Boots: 1/2 inch wg (125 Pa) pressure class, fibrous glass.

2.2 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.
   3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   4. For Use with Flexible Ducts: UL labeled.
   5. Manufacturers:
      a. Carlisle HVAC Products; Hardcast Iron-Grip 601 Water Based Duct Sealant.
      b. Design Polymerics; 1010: www.designpoly.com.com/#sle.
      c. Ductmate Industries, Inc, a DMI Company
      d. Substitutions: See Section 016000 - Product Requirements.

D. Gasket Tape: Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle rings connections.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

F. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
   1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
   2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
   3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
   4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
   5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

D. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.4 MANUFACTURED DUCTWORK AND FITTINGS

A. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
   1. Manufacture in accordance with SMACNA (DCS).

B. Round Ducts: Round lockseam duct with galvanized steel outer wall.
   1. Manufacture in accordance with SMACNA (DCS).

C. Flexible Ducts: Black polymer film supported by helically wound spring steel wire.
   1. UL labeled.
   2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   3. Pressure Rating: 4 inches wg (1000 Pa) positive and 0.5 inches wg (175 Pa) negative.
   4. Maximum Velocity: 4000 fpm (20.3 m/sec).
   5. Temperature Range: Minus 20 degrees F to 175 degrees F (Minus 28 degrees C to 79 degrees C).

D. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in

accordance with SMACNA (DCS).
1. Manufacturers:
   a. Carlisle HVAC Products.
   b. Ductmate Industries, Inc, a DMI Company.
   c. MKT Metal Manufacturing.
   d. Substitutions: See Section 016000 - Product Requirements.

E. Round Duct Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
1. Manufacturers:
   a. Ductmate Industries, Inc, a DMI Company.
   b. Substitutions: See Section 016000 - Product Requirements.

2.5 CASINGS AND PLENUMS

A. Fabricate casings in accordance with SMACNA (DCS) and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch (100 mm) high concrete curbs. At floor, rivet panels on 8 inch (200 mm) centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gauge, 0.0478 inch (1.21 mm) expanded metal mesh supported at 12 inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge, 0.0598 inch (1.52 mm) sheet steel back facing and 22 gauge, 0.0299 inch (0.76 mm) perforated sheet steel front facing with 3/32 inch (2.4 mm) diameter holes on 5/32 inch (4 mm) centers. Construct panels 3 inches (75 mm) thick packed with 4.5 lb/cu ft (72 kg/cu m) minimum glass fiber insulation media, on inverted channels of 16 gauge, 0.0598 inch (1.52 mm) sheet steel.

E. Thermal Panels:
1. Material: Steel-faced composite panel with noncombustible structural high density mineral fiber core for plenum fabrication.
   a. Facing: Galvanized steel (G90), 24 gauge, 0.0275 inch (0.701 mm).
   b. Finish: Unpainted.
   c. Core: Mineral wool board.
   d. Structural: Nonload bearing.
2. R-Value: 12 when tested in accordance with ASTM C177.
3. Manufacturers:
   a. DuraSystems Barriers Inc; DuraTherm: www.durasystems.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Flexible Ducts: Connect to metal ducts with draw bands.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

I. Use double nuts and lock washers on threaded rod supports.

J. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.

K. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

L. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

3.2 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.3 LEAKAGE TESTING

A. Leak test each ductwork system before ductwork is insulated and concealed.
   1. Test all ductwork. For positively-pressurized ductwork follow general procedures (Chapter 4) and use apparatus (Chapter 6) as outlined in the referenced SMACNA HVAC Air Duct Leakage Test Manual. For negatively-pressurized ductwork, follow general procedures (Chapter 4) and use apparatus (Chapter 6) as outlined in the referenced SMACNA HVAC Air Duct Leakage Test Manual, except that the test blower shall exhaust air from the ductwork being tested.
   2. Duct construction pressure classifications for all ductwork are shown in the DUCT ASSEMBLIES. Test all ductwork at 100 percent of the specified pressure classifications.
   3. The maximum allowable leakage shall be the percent of total rated airflow (cfm) capacity for each ductwork system at SMACNA duct class 3 in. wg.
   4. All devices, including access doors, airflow measuring devices, sound attenuators, damper casings, sensors, test ports, etc. that are installed in duct systems shall be included as part of the duct systems leakage allowance and tested accordingly. Air

leakage for equipment, such as fans, air handling units and terminal boxes, has been accounted for separately and all equipment has been specified to meet specific air leakage criteria. Independently leak test all equipment after installation to assure compliance with Specifications and shall isolate this equipment during ductwork leak testing. As an alternate, equipment may be leak tested as part of the duct system, provided that this is noted on the report forms and that leakage rate allowances for ductwork and equipment are identified separately on the forms.

5. If tests show that ductwork leakage is greater than that allowed, ductwork shall be resealed and retested until allowable leakage is not exceeded, at no additional cost to the Owner. All tests may be witnessed and results verified by the Owner's Representative. Submit field test report certifying that the ductwork does not exceed the maximum allowable leakage.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Duct access doors.

D. Duct test holes.

E. Fire dampers.

F. Flexible duct connectors.

G. Volume control dampers.

H. Miscellaneous products:
   1. Damper operators.
   2. Damper position switch.
   3. Duct opening closure film.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 230548 - Vibration and Seismic Controls for HVAC.

C. Section 233100 - HVAC Ducts and Casings.

D. Section 253513 - Integrated Automation Actuators and Operators: Damper operators.

E. Section 253516 - Integrated Automation Sensors and Transmitters: Damper position switch.

F. Section 253523 - Integrated Automation Control Dampers: Product furnishing.

1.3 REFERENCE STANDARDS

A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

C. NFPA 92 - Standard for Smoke Control Systems; 2018.

D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

F. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

G. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

H. UL 555C - Standard for Safety Ceiling Dampers; 2014 (Revised 2017).

I. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

J. UL 1978 - Grease Ducts; Current Edition, Including All Revisions.

K. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

E. Project Record Drawings: Record actual locations of access doors and test holes.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Fusible Links: One of each type and size.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
1. Carlisle HVAC Products.
2. Krueger-HVAC, Division of Air System Components.

3. Titus HVAC, a brand of Johnson Controls.
4. Price Industries
5. Substitutions: See Section 016000 - Product Requirements.

2.2 BACKDRAFT DAMPERS - METAL

A. Manufacturers:
   1. Nailor Industries, Inc.
   2. Ruskin Company.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 BACKDRAFT DAMPERS - FABRIC

A. Fabric Backdraft Dampers: Factory-fabricated.
   1. Blades: Neoprene coated fabric material.
   2. Birdscreen: 1/2 inch (12 mm) nominal mesh of galvanized steel or aluminum.
   3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.4 DUCT ACCESS DOORS

A. Manufacturers:
   1. Acudor Products Inc, a Division of Nelson Industrial Inc.
   2. Ductmate Industries, Inc, a DMI Company.
   3. MKT Metal Manufacturing.
   4. Nailor Industries, Inc.
   5. Ruskin Company.
   6. SEMCO LLC.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch (25 mm) thick insulation with sheet metal cover.
   1. Less Than 12 inches (300 mm) Square: Secure with sash locks.
   2. Up to 18 inches (450 mm) Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.
   5. High Temperature Duct Access Doors:
      a. Comply with NFPA 96.
      b. Comply with UL 1978.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.6 FIRE DAMPERS

A. Manufacturers:
   1. Louvers & Dampers, Inc, a brand of Mestek, Inc.
   2. Nailor Industries, Inc.
   3. NCA, a brand of Metal Industries Inc.
   4. Pottorff.
   5. Ruskin Company.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling (Radiation) Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame and 16 gage, 0.0598 inch (1.52 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
   1. Boot Fitting: Factory-provided el type (90 degree). Include field-provided collar.
   2. Box Fitting: Factory-provided 26 gage, 0.0179 inch (0.45 mm) with field-provided collar.
   3. Rated for one hour service in compliance with UL 555C.

D. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.

F. Multiple Blade Dampers: 16 gage, 0.0598 inch (1.52 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch (3.2 by 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.

2.7 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:
   1. Carlisle HVAC Products.
   2. Ductmate Industries, Inc, a DMI Company.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).
      a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
   2. Metal: 3 inches (75 mm) wide, 24 gage, 0.0239 inch (0.61 mm) thick galvanized steel.

D. Leaded Vinyl Sheet: Minimum 0.55 inch (14 mm) thick, 0.87 lbs per sq ft (4.2 kg/sq m), 10 dB attenuation in 10 to 10,000 Hz range.

E. Maximum Installed Length: 14 inch (356 mm).

2.8 SMOKE DAMPERS

A. Products furnished per Section 253523.

B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by electric actuator.

D. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.9 VOLUME CONTROL DAMPERS

A. Products furnished per Section 253523.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches (600 mm) size in either direction, and two gages heavier for sizes over 24 inches (600 mm).
   2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch (6 mm) diameter rod in self aligning, universal joint action, flanged bushing with set screw .

D. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
   2. Blade: 24 gage, 0.0239 inch (0.61 mm), minimum.

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch (1.21 mm), minimum.

F. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

G. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends.

2.10 MISCELLANEOUS PRODUCTS

A. Damper manual operators furnished per Section 253513.

B. Damper position switch furnished per Section 253516.

C. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
   1. Thickness: 2 mils (0.6 mm).
   2. High tack water based adhesive.
   3. UV stable light blue color.
   4. Elongation Before Break: 325 percent, minimum.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch (200 by 200 mm) size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch (100 by 100 mm) for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

G. Demonstrate re-setting of fire dampers to Owner's representative.

H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
   1. Refer to Section 230548.

J. For fans developing static pressures of 5.0 inches (1250 Pa) and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

L. Use splitter dampers only where indicated.

M. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ceiling exhaust fans.

1.2 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.

B. Section 230548 - Vibration and Seismic Controls for HVAC.

C. Section 233300 - Air Duct Accessories: Backdraft dampers.

D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

E. AMCA 211 - Certified Ratings Program Product Rating Manual for Fan Air Performance; 2022, with Editorial Revision (2023).

F. AMCA 260 - Laboratory Methods of Testing Induced Flow Fans for Rating; 2020.

G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

I. AMCA 311 - Certified Ratings Program Product Rating Manual for Fan Sound Performance; 2016.

J. NEMA MG 1 - Motors and Generators; 2018.

K. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

L. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Fan Belts: One set for each individual fan.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.7 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.1 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.2 CEILING EXHAUST FANS

A. Manufacturers:

1. Carnes, a division of Carnes Company Inc.
2. Greenheck Fan Corporation.
3. Panasonic Corporation of North America.
4. PennBarry, Division of Air System Components.
5. Twin City Fan & Blower.
6. Lauren Cook Company.
7. Substitutions: See Section 016000 - Product Requirements.

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

C. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted switch.

D. Grille: Molded white plastic.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Hung Cabinet Fans:
1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 230548.
2. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.

E. Provide sheaves required for final air balance.

F. Install backdraft dampers on inlet to roof and wall exhausters.

G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers:
   1. Perforated ceiling diffusers.
   2. Rectangular ceiling diffusers.
   3. Slot ceiling diffusers.

B. Registers/grilles:
   1. Ceiling-mounted, egg crate exhaust and return register/grilles.
   2. Ceiling-mounted, exhaust and return register/grilles.
   3. Ceiling-mounted, linear exhaust and return register/grilles.
   4. Ceiling-mounted, supply register/grilles.
   5. Wall-mounted, exhaust and return register/grilles.

C. Duct-mounted supply and return registers/louvers.

D. Wall and ceiling gypsum board access panels.

E. Louvers:
   1. Combination louvers.

1.2 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.

E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

F. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

I. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carnes, a division of Carnes Company Inc.

B. Krueger-HVAC.

C. Metalaire, a brand of Metal Industries Inc.

D. Price Industries.

E. Titus, a brand of Air Distribution Technologies.

F. Tuttle and Bailey.

G. Substitutions: See Section 016000 - Product Requirements.

2.2 DIFFUSERS, REGISTERS, AND GRILLES:

A. Manufacturers:
   1. Krueger-HVAC
   2. Metalaire, a brand of Metal Industries Inc.
   3. Price Industries.
   4. Titus, a brand of Air Distribution Technologies.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Refer to schedules on drawings for types and models.

C. Type: Provide square, stamped, multi-core, square, adjustable pattern, stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, and multi-louvered diffuser to discharge air in 360 degree, one way, two way, three way, and four way pattern with sectorizing baffles where indicated.

D. Connections: As indicated on drawings.

E. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

F. Color: As selected by Architect from manufacturer's full range.

G. Accessories: Provide volume control damper; operating rod extension and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

2.3 LOUVERS

A. Manufacturers:
   1. NCA, a brand of Metal Industries Inc.
   2. Ruskin Company.
   3. Pottorff.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Type: Frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch (13 mm) square mesh screen over intake or exhaust end. Coordinate frame depth with wall systems.

C. Fabrication: 12 gage, 0.1046 inch (2.66 mm) thick extruded aluminum thick galvanized steel welded assembly, with factory anodized finish.

D. Color: To be selected by Architect from manufacturer's full range.

E. Mounting: Furnish with interior angle flange for installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 099123.

END OF SECTION

SECTION 238126.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor air handling (fan and coil) units for ducted systems.

C. Controls.

1.2 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. AHRI 610 (I-P) - Performance Rating of Central System Humidifiers for Residential Applications; 2014.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2016, with Addendum (2017).

E. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

F. NEMA MG 1 - Motors and Generators; 2018.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

I. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Design Data: Indicate refrigerant pipe sizing.

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of experience and approved by manufacturer.

1.5 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
   1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
   2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

2.2 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
   1. Air Flow Configuration: Upflow.
   2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
   1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
   2. Motor Electrical Characteristics:

C. Air Filters: 1 inch (25 mm) thick urethane, washable type arranged for easy replacement.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
2. Manufacturers: System manufacturer.

2.3 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.

D. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.

2.4 ACCESSORY EQUIPMENT

A. Room Humidistat: Electric, adjustable, to energize humidifier when fan operating, to maintain setting.

B. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
   1. Automatic switching from heating to cooling.
   2. Preferential rate control to minimize overshoot and deviation from setpoint.
   3. Thermostat Display:
      a. Actual room temperature.
      b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

C. Verify that proper fuel supply is available for connection.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

D. Install humidifiers in accordance with AHRI 610 (I-P) or AHRI 611 (SI).

END OF SECTION

SECTION 238415 - STEAM HUMIDIFIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrode steam humidifiers.

1.2 RELATED REQUIREMENTS

A. Section 221005 - Plumbing Piping.

B. Section 230913 - Instrumentation and Control Devices for HVAC: Humidistats.

C. Section 232213 - Steam and Condensate Heating Piping.

1.3 REFERENCE STANDARDS

A. AHRI 610 (I-P) - Performance Rating of Central System Humidifiers for Residential Applications; 2014.

B. AHRI 611 (SI) - Performance Rating of Central System Humidifiers for Residential Applications; 2014.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.

C. Shop Drawings: Indicate layout of system and components.

D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide two year manufacturer warranty for humidifier unit except the cylinder.

PART 2 PRODUCTS

2.1 ELECTRODE STEAM HUMIDIFIERS

A. Manufacturers:
   1. Armstrong International, Inc
   2. Dri-Steem Corporation
   3. Condair, Inc.

B. Humidifier: Self-contained, cylinder, microprocessor-controlled, electrode steam-generating unit complying with AHRI 610 (I-P).

C. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing. Incorporate water fill with 1-inch (25 mm) air gap and integral air gap on drain. Fill solenoid valve shall incorporate built-in strainer, pressure-reducing and flow-regulating orifice.

D. Cabinet: Steel, 0.058 inches (1.5 mm) with enamel finish, with hinged and lockable access door.

E. Electric Service: Unit protected by internal fusing on line voltage leads and automatic emergency drain trigger. Incorporate electrical terminals for installation of humidistat, duct high-limit humidistat, interlock to fan or air flow switch.

F. Control: Fully modulating control to provide gradual 0 to 100 percent capacity. Maximum capacity shall be field adjustable for 0 to 100 percent. High-water probe shall prevent overfilling. Multiple cylinder humidifiers shall have duplicate internal control circuitry to allow each cylinder to be independently controlled.

G. Drain Cycle: Field adjustable with drain duration range of 2 to 128 seconds and drain interval range of 0.25 to 16 hours, with one drain valve for each generator.

H. Steam Distributor: Stainless steel steam dispersion tube suitable for insertion in duct with condensate separator and return leg to remove condensate from distributor and return to humidifier fill. Provide 1-1/2-inch (40 mm) diameter reinforced rubber steam hose from generator to dispersion tube.

I. Display: Digital, providing select monitoring of unit amperage draw, percentage demand from humidistat, steam output, and manually set capacity adjustment. Lamps to indicate full cylinder.

J. Humidistat:
   1. Wall mounted, solid state electronic sensor, 24 volt.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 260000 - GENERAL REQUIREMENTS FOR DIVISION 26 WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF THE WORK

A. Provide under this Division of the Specification a complete electrical system, fully adjusted, tested, and commissioned for use as indicated on the Drawings and as specified herein.

B. Work Specified in This Division:

260000 General Requirements for Division 26 Work

260100 Basic Electrical Materials and Methods

260200 Service Equipment

260519 Low-voltage Electrcal Power Conductors and Cables

260526 Grounding and Bonding for Electrical Systems

260529 Hangers and Support for Electrical Systems

260533.13 Conduit for Electrical Systems

260533.16 Boxes for Electrical Systems

260548 Vibration and Seismic Control for Electrical System

260553 Identitifcation for Electrical Systems

260583 Wiring Connections

260923 Lighting Control Devices

262416 Distribution Panelboards, Branch Circuit Panelboards and Load Centers

262726 Wiring Devices

262813 Fuses

262816.16 Enclosed Switches

263213 Generators (CB)

263600 Transfer Switches

265100 Interior Lighting

265600 Exterior Lighting

284600 Fire Detection and Alarm

C. The Contractor shall examine all other Divisions of the Specification to determine the full extent of related work required to be performed under this Division. Failure to do so will not relieve the Contractor of responsibility to perform all work required for a complete and satisfactory installation.

D. The Contractor shall recognize that various electrical communication equipment originate within and/or connect and/or interface with electrical equipment in other buildings at this location/building complex. The Contractor shall be responsible to verify that he is fully aware of the amount of wiring/cabling that must be routed from this building to any other building that has been constructed or is being constructed together with this building. Particular attention must be taken in the implementation of Specifications:

E. The Contractor shall recognize that various electrical communication equipment originate within and/or connect and/or interface with electrical equipment in other buildings at this location/building complex. The Contractor shall be responsible to verify that equipment and systems are protected from the effects of multiple grounds and from the effects of lightning strikes to the building complex.

1.3 CODES AND STANDARDS

A. Codes and Standards listed below, insofar as they apply, form a part of these Specifications, the same as if they were fully written and shall be followed as minimum requirements. Where standards conflict, that standard with the more stringent requirements shall be applicable. This shall not be construed as relieving the Contractor from providing the highest grade of material and workmanship specified.

B. The Contractor shall give written notice to the Architect of any materials or apparatus believed in violation of laws, ordinances, rules or regulations, or Authorities Having Jurisdiction.

C. All equipment shall comply with all applicable requirements of laws, codes, ordinances, legislation, etc., of all Federal, State, and Local Authorities, whether or not indicated on the Contract Documents.

D. The referenced codes shall include any and all supplements, addenda, memoranda, information bulletins and any other changes and additions effective prior to the Date of Substantial Completion by adoption of the local Authority Having Jurisdiction.

E. Modifications required by the Authorities Having Jurisdiction shall be made without additional charge to the Owner.

F. Where alterations to and/or deviations from the Contract Documents are required by the Authorities, report the requirements to the Architect and secure his approval before starting the alterations.

G. Where Contract Documents' requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern.

H. All rules and regulations of the Underwriters Laboratories shall be complied with whether or not indicated in the Contract Documents. Provide Division 26 equipment having UL labels or labeled by an independent testing agency acceptable to the Authority Having Jurisdiction.

I. All work shall comply with the following codes and standards.
   1. Codes:
   2. New Jersey Adopted Version of IECC, 2021 Edition.
   3. New Jersey Adopted Version of ASHRAE 90.1, 2019 Edition.
   4. New Jersey Adopted Version of IBC, 2021 Edition
   5. New Jersey Adopted Version of National Electrical Code, 2002 edition.
   6. Standards:
      National Fire Protection Association (NFPA).
      Underwriters Laboratories, Inc. (UL).
      American National Standards Institute (ANSI).
      National Electrical Manufacturers Association (NEMA).

1.4 PERMITS

A. The Contractor shall be responsible for obtaining and paying for all permits, licenses, and inspection certificates required for all work in accordance with the provisions of the Contract Documents.

1.5 DEFINITIONS

A. "Provide": to supply, install and make complete, safe, and operable, the particular work referred to unless specifically indicated otherwise.

B. "Install": to erect, mount and make complete with all related accessories.

C. “Furnish” or "supply": to purchase, procure, acquire, and deliver complete with related accessories.

D. "Work": includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.

E. "Wiring": includes raceway, fittings, wire, boxes, and all related accessories.

F. "Concealed": not in view, installed in masonry or other construction, within furred spaces, double partitions, hung ceilings, trenches, crawl spaces, or enclosures.

G. "Exposed": in view, not installed underground or "concealed" as defined above.

H. "Indicated," "shown," or "noted": as indicated, shown or noted on drawings or specifications.

I. "Similar" or "equal": of base bid manufacturer, equal in quality, materials, weight, size, performance, design and efficiency of specified product, conforming with "Base Bid Manufacturers."

J. "Reviewed," "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by or to Architect and/or Engineer.

1.6 GUARANTEE

A. The Contractor will guarantee in form satisfactory to the Owner, that all Work installed will be free from any and all defects in workmanship and materials for a period of one year, to include one full heating and one full cooling season, from the date of certification of substantial

completion or acceptance by the Owner, whichever is later. Guarantee that all apparatus will develop capacities and characteristics specified.

B. During the guarantee period the Contractor shall remedy defective workmanship, materials, and apparatus performance, without cost to the Owner, within a reasonable time to be specified by the Owner. In default thereof, the Owner may have such work done and charge all costs to the Contractor in accordance with the General conditions of the Contract and Division 1.

C. Provide product warranties as specified in the various Sections of this Division. Minimum product warranty shall be one year.

1.7 COMPLETE PERFORMANCE OF WORK

A. Work shall be executed in strict accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen.

B. Provide labor, materials, apparatus, and appliances essential to the complete functioning of the systems described and indicated or which may be reasonably implied as essential whether mentioned in the Contract Documents or not.

C. In cases of doubt as to the Work intended, or in the event of need for explanation thereof, the Contractor shall request supplementary instructions from the Architect.

D. Provide skilled journeymen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper installation of the Work of this Division.

1.8 COOPERATION WITH OTHER TRADES

A. Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Architect and Owner) any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Where the work of various trades will be installed in close proximity to one another, or where there is evidence that the work of one trade will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. Prior to the execution, procurement or fabrication of any work, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1/4-inch = 1-foot 0-inch clearly showing work of all trades. If the Contractor allows one trade to install his work before coordinating with work of other trades, the Contractor shall make necessary changes to correct the condition without extra charge.

1.9 DRAWINGS

A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, conduit, etc. are diagrammatic unless specifically dimensioned, and do not necessarily indicate every required fitting, junction box, pull box, relay or similar items required for a complete installation. Consult the Architectural Drawings and details for exact location of fixtures and equipment. Where same is not definitely located, obtain the information from the Architect before proceeding.

B. The Contractor shall follow the Drawings in laying out the work and check drawings of all trades to verify spaces in which work will be installed. Maintain maximum headroom and where space

conditions appear inadequate, the Architect shall be notified before proceeding with the installation.

C. Any apparatus, appliance, material or work not shown on the Drawings but mentioned in the Specifications, or vice versa, shall be provided by the Contractor without additional expense to the Owner.

D. Where variances occur between the Drawings and the Specifications, or within either document itself, the items or arrangement of better quality, greater quantity, or higher cost shall be included in the contract price. The Contractor shall request clarification in writing from the Architect on which item and manner in which the work shall be installed.

1.10 SURVEYS AND MEASUREMENTS

A. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site, and check the corrections of same as related to the Work and submittals.

B. Should the Contractor discover any discrepancy between actual measurements and those indicated which would prevent following intent of the Drawings and Specifications, he shall notify the Architect and shall not proceed until he has received interpretations from the Architect.

1.11 EQUIPMENT FURNISHED BY OTHERS

A. When so specified or shown, the Contractor shall install any equipment furnished by others.

B. The Contractor shall receive at the site, unload, uncrate, store, protect, set in place, and connect up completely any such equipment or fixtures which require electrical service connections. All such connections shall be in accordance with the Manufacturer's recommendations and these Specifications.

C. The Contractor shall consult Manufacturer's literature and inspect the actual piece of equipment or fixture to determine roughing in dimensions and locations for all services.

D. The Contractor shall exercise special care in handling and protecting such equipment and fixtures and shall be responsible for the cost of replacing any such equipment or fixtures which are missing; and for the cost of repairing any damage to each piece of equipment and fixtures or finished work, caused by mishandling or failure to protect on the part of the Contractor.

1.12 CONFERENCE PRIOR TO START OF WORK

A. Immediately upon the award of this Contract, but prior to commencing any Work, the Contractor together with designated major subcontractors shall confer with the Architect and Engineer concerning the Work under this Contract.

B. The conference will be held at a mutually agreed place and acceptable time.

1.13 PROTECTION

A. The Contractor shall maintain protection of the Work and materials during construction from theft, injury or damage.

B. The Contractor shall carefully store material and equipment received on site which are not immediately installed.

C. The Contractor shall provide temporary covers on enclosures as required during construction to prevent damage.

D. The Contractor shall be responsible for all work and equipment on project until inspected, tested and accepted by the Owner.

E. Any equipment damaged shall be refinished back to original condition or replaced at the Architect’s/Engineer’s discretion.

1.14 MANUFACTURER'S RECOMMENDATIONS

A. With exceptions as specified or indicated in the Contract Documents, apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment per manufacturer's current printed recommendations. Keep copies of such printed recommendations at job site.

1.15 SPACE LIMITATIONS

A. Equipment has been chosen which will fit into the physical spaces provided and indicated, and allow for access, servicing, removal and replacement of parts, etc. The Contractor shall provide adequate space for clearance in accordance with the Code requirements and the requirements of the local Authorities Having Jurisdiction for all equipment, including "future equipment" to be installed at a later date.

B. In the preparation of Contract Documents, a reasonable effort to accommodate specified Equipment Manufacturers' space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for access and proper fit rests with the Contractor.

C. Physical dimensions and arrangements of equipment to be installed shall be subject to the Architect's review.

D. The Contractor shall be responsible for confirming the sufficiency of the size of shafts and chases, the adequate thickness of partitions and adequate clearance in double partitions and hung ceilings for the proper installation of his work. Such spaces and clearances shall be kept to the minimum size required.

1.16 SUBMITTALS

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain complete submittals from the manufacturers, suppliers, vendors, subcontractors, sub-subcontractors, for all materials and equipment specified in this Division and submit data and details of such materials and equipment to the Architect and Engineer.

B. Prior to forwarding submittals to the Architect and Engineer, the Contractor shall review and stamp all submittals to indicate that the equipment, materials, methods, etc. represented by the

submittals are in compliance with the Contract Documents prior to submission.

C. The Contractor shall check all materials and equipment after their arrival on the job site and verify their compliance with approved submittal and the Contract Documents.

D. A period of two weeks, exclusive of transmittal time, will be required in the Engineer's office each time a submittal is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his work.

E. Submittal Types:
   1. Product data submittal: Manufacturers' literature or sample which the Contractor intends to provide for the Project. Product data submittals will be reviewed for compliance with the information shown and the design concept expressed in the Contract Documents. Approval of a specific item does not constitute approval of an assembly of which the item is a component. Submit equipment operating data, general arrangement, materials of construction, etc.
   2. Quality control submittal: Shop drawing of an assembly of components with construction dimensions and details as appropriate. The Contractor is responsible for construction means, methods, techniques, sequences and procedures and for the accuracy of dimensions, quantities, substantiating instructions for installations of equipment and systems.
   3. Contract closeout submittals: Information required at substantial completion of the Project. Contract closeout submittals will be reviewed for conformance with the specified content.

F. Approval of product data shall not relieve the Contractor of the responsibility for errors that may be contained therein, or for deviations from requirements in the Contract Documents. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the product data the Contract Documents shall govern the work and are neither waived nor superseded in any way by submittal review.

G. For each submittal, the Contractor shall provide a cover sheet on his business letterhead which consist of:
   1. Whether or not item being submitted is the "Basis of Design", "Alternate Specified Item" or "Substitute Item" as indicated in the Contract Documents.
   2. In the event that the item or equipment being submitted is not the "Basis of Design", Contractor shall state that they have reviewed the Contract Documents and will provide any modifications or revisions to the Contract required to properly install the equipment. This shall be accomplished at no additional cost to the Owner, in compliance with Section 260000-2.02 “Materials.”

H. Provide submittals with the following:
   1. Cover sheet with submittal title, submittal number, name of Project, names of Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier/vendor, the submittal date, the dates of any revisions, and the applicable spec section and paragraph numbers.
   2. Clear identification of each manufacturer.
   3. Irrelevant catalog information deleted.

I. Provide submittals in the following quantities.
   1. Product data submittals: as specified in Division 1.
   2. Quality control submittals: two copies; one for the Architect's file and one for the Engineer's file. Provide two (2) additional copies for the Owner.
   3. Contract closeout submittals: minimum of two copies or as specified in the various sections; both approved copies will be turned over to the Owner.

J. The Contractor shall maintain one complete, up-to-date set of all reviewed submittals and all quality control submittals at the project site. At the conclusion of the project, this submittal file shall be turned over to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as may be described in PART 1 and PART 3 of this Section, refer to PART 2 of the various Sections of Specification Division 26, ELECTRICAL.

2.2 MATERIALS

A. The word "Provide" is defined as requiring the Contractor to "furnish, erect, and install complete and commission for use" the item to which it refers.

B. All materials and apparatus required for the work except as specified otherwise, shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged to fit properly into the building spaces. Where no specific kind or quality of material is given, a first class standard article as approved by the Architect shall be provided.

C. Where any specific material, process or method of construction, or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance as specified or noted on the Drawings. In all cases, the Contractor shall verify the duty specified with the specific characteristics of the equipment offered for approval.

D. Materials, equipment, etc., used in the Work shall not contain asbestos or PCB's in any form or composition.

E. Equipment designated as "Basis of Design" has been coordinated for structural penetrations; duct, piping, and electrical connection; operating and service (maintenance) requirements; and physical size with regard to space where equipment is housed. Other specified manufacturers of like equipment are acceptable contingent on the Contractor providing a complete installation and maintaining full responsibility to provide, at no additional cost, any modifications to the structure or configuration of adjoining equipment and the installation that is required to properly install, operate, and service the equipment being used.

F. The Contractor shall provide equipment, materials, etc. from the specified manufacturers. Where no alternate manufacturers are specified the exact make specified shall be provided. The Architect shall have the right to reject any alternative submitted and to insist on the specified material.

G. All component parts of each item of equipment or device shall bear the manufacturers nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc., in order to facilitate maintenance or replacement. The nameplate of a Subcontractor or Distributor will not be acceptable.

H. Unless otherwise specifically indicated in the Drawings or Specifications, all equipment and materials shall be applied with the approval of the Architect in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the

manufacturer recommends.

2.3 SHORT-CIRCUIT AND PROTECTION COORDINATION STUDY

A. Power System Analysis Software Program (Software).
   1. Software shall have a robust Quality Assurance Program in place and subject to QA audits assessments.
   2. Studies shall be performed using the latest version of approved software:
      a. ETAP (Developed by ETAP / Operation Technology, Inc.)
      b. SKM Systems Analysis Power*Tools for Windows (PTW) software program
      c. Approved equal
   3. Software Program Requirements
      a. Software shall comply with IEEE 399, IEEE 141, IEEE 242, IEEE 1015, IEEE 1584.

B. The Contractor shall submit for acceptance as a product data submittal type brochure as prepared by equipment supplier only, each of which shall include complete short-circuit and protection coordination studies with coordination plots for each switchboard, distribution, and branch panelboard. The studies shall include the medium voltage power distribution system and relay characteristics, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, impedance diagrams, conclusions, and recommendations. Short-circuit momentary duties, when applicable, and interrupting duties shall be calculated on the basis of an assumed fault at each switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the systems. The short-circuit tabulations shall include the fault impedances, X to R ratios, asymmetry factors, KVA, symmetrical, and asymmetrical fault currents.

C. The shop drawing brochure coordination plots required shall graphically indicate the coordination proposed for the several systems centered on full scale log-line diagrams and legends, associated medium voltage power distribution relay or system characteristics, motor controller fuses and relays, significant motor starting characteristics, complete operating bands for switchboard circuit breaker trip devices, fuses, if applicable, and the associated system load protective devices, etc. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, and time dial setting required. The long-time region of the coordination plots shall indicate a complete tap scale for each medium-voltage relay, full-load current and 150, 400 or 600 percent full-load current transformer parameter, and designate the pickups required for the low-voltage circuit breakers. The short-time region shall indicate the medium-voltage relay instantaneous elements, the magnetizing inrush, and ANSI withstand transformer parameters, the low-voltage circuit breaker, short-time and instantaneous trip devices, fuse manufacturing tolerance bands, including the low-voltage network protector fuses, when applicable, significant symmetrical and asymmetrical fault currents, etc. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer parameters, which shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults. The transformer damage curve shall be included for each transformer when the selected protective device is not within the associated parameters. Low-voltage power circuit breakers shall be separated from each other and the associated primary protective device by a 16 percent current margin for line-to-line faults. Medium-voltage relays shall be separated by a 0.4 second time margin when the maximum three-phase fault flows, to assure proper selectivity. The protective device characteristics or operating bands shall be suitably terminated to reflect the actual symmetrical and asymmetrical fault currents sensed by the device.

D. The shop drawing brochures may be prepared with a network analyzer or a digital computer, but shall include complete fault calculations as hereinbefore specified for each proposed and

ultimate source combination. It should be noted that source combinations may include proposed and future power company feeders, large motors, or generators. Brochures based on written calculations shall include sample calculations for each voltage category. The shop drawing brochures shall be prepared by the power circuit breaker or equipment manufacturer who furnished the switchgear or equipment for the incoming service to the site.

E. The Contractor shall note that the Drawings and Specifications indicate the general requirements for the motors, motor-starting equipment, low-voltage equipment, etc., but additional specific characteristics of equipment furnished shall be determined in accordance with the results of the short-circuit and protection coordination study. The equipment design discrepancies and the proposed corrective modifications as required shall be submitted with the short-circuit, available fault current calculation and protection coordination study with any variations clearly noted on the subsequent shop drawings. Necessary field settings, adjustments, and changing fuse type or circuit breaker ratings for conformance with the approved short-circuit and protection coordination study shall be accomplished by the particular manufacturer or by the Contractor without additional expense to the Owner.

F. Contractor may reduce short circuit ratings of equipment listed as basis of design if the study allows and with architect approval.

2.4 SUBMITTALS

A. The following equipment shall be by the same manufacturer. Submit this equipment together in a covered binder with each item separated by a tabbed section.
   1. Enclosed switches
   2. Panelboards

B. Provide short circuit study and equipment installation drawing with these submittals. In the absence of the short circuit study or arc fault study, the above product data submittals will not be reviewed.

PART 3 - EXECUTION

3.1 COORDINATION

A. The Contractor shall assure full cooperation of all trades and shall furnish in writing all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Where necessary, prepare composite working drawings at a suitable scale not less than 1/4-inch equals one foot, zero inches, clearly showing how the work of this Division is to be installed in relation to the work of all trades. Any work installed in conflict with the work of other trades shall be corrected at no additional cost to the Owner.

C. The Contractor may, subject to the acceptance of the Architect and without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of all trades or for the proper execution of the work.

D. Electrical Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Coordinate with the Architectural Drawings and details for exact location of fixtures and equipment.

E. The Contractor shall follow Drawings in layout work and shall coordinate all trades to verify spaces in which work shall be installed. Maintain maximum headroom or space conditions. Where space conditions appear inadequate, the Architect shall be notified before installation. Do not proceed with the installation until receiving clarifying instructions.

3.2 SLEEVES, PLATES, AND INSERTS

A. The sleeves, plates, and inserts shall be carefully located in advance of the construction of walls, slabs, and decks.

B. Sleeves shall be provided for all conduit passing through metal decks or concrete slabs. Sleeves shall be provided for all conduit passing through masonry, concrete, tile, and gypsum wallboard construction.

C. Sleeves in concrete floor slabs may be Schedule 40 P.V.C. pipe.

D. Fasten sleeves securely in slabs, decks, and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other material from being forced into the space between conduit and sleeves during construction.

E. Where sleeves are placed through slabs, decks, or fire-rated wall construction and following placing of electrical service therein, resulting opening and unused sleeves shall be filled with factory built devices or with manufactured fill, void, or cavity materials "Classified" by Underwriters' Laboratories, Inc. for use as a Through-Penetration Firestop. All firestop devices and systems shall be approved for such use by the authority having jurisdiction. The fire safing system used shall maintain the fire resistance rating of the building component that is penetrated. Fire safing systems and devices shall comply with ASTM E 814 (UL 1479). Submittal data for fire safing systems shall include the U.L. System Numbers listed in the U.S. Building Materials Directory under which the material was tested in accordance with ASTM E 814 (UL 1479) for use in a Through-Penetration Firestop System. Excessive shrinkage of the fire stopping materials which would permit the transmission of smoke or water prior to exposure to a fire condition is unacceptable. Where a mastic coating is used to seal the surface of the firestop, the mastic shall be non-hardening. The fire safety system used shall accommodate expansion and contraction without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal. Approved firestop sealing component/systems are as follows:
   1. Tremco Fire-Resistive Joint System using Dymeric sealant and Cerablanket-FS mineral filler.
   2. Dow Corning 3-6548 Silicone RTV Foam.
   3. 3M Fire Barrier Penetration Sealing Systems (Electro Products Divisions).
   4. STI Pensil PEN200 Silicone RTV Foam.
   5. T&B Flame-Safe Fire Retardant Products.

F. Sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4 inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be four inches wider all around than the sleeve it encircles. The entire assembly shall be hot dipped galvanized after fabrication. Seal off annular opening between conduit and sleeve with "Link Seal" casing seal as manufactured by GPT, a division of EnPro Industries. The pipe sleeve shall be sized to accommodate the GPT casing seal. Casing seals shall be Series LS-300 for conduit size 3/4 inches through 4 inches and Series LS-400 for conduit sizes 5 inches and longer.

G. Check floor and wall construction finishes to determine proper length of sleeves for various locations and make actual lengths to suit the following.

1. Terminate sleeves flush with walls, partitions, and ceilings. Sheet metal thimbles of adequate strength to resist deformation by construction materials may be used in non-structural walls and ceilings.
2. In areas where conduits are concealed, as in chases, formed penetrations may be used.
3. In area where conduits are exposed, extend sleeves 2 inches above finished floor.

H. Sleeves through beams or within 30 inches of column center lines shall be ASTM A-500 or A-501 steel pipe. All other sleeves shall be Schedule 40, ASTM A-120 galvanized or black steel pipe where required by structural engineer or where required to extend above the floor.

3.3 EXCAVATING AND BACKFILLING

A. Excavation as required to acceptably install work covered in this Division of the Specifications shall be provided as a portion of the work of this Division.

B. It shall be the responsibility of the Contractor to check the indicated elevations of the utilities entering and leaving the building. If such elevations require excavations lower than the footing levels, the Architect shall be notified of such conditions before excavations are commenced.

C. Contractor shall be responsible for backfilling areas indicated but not used by utility companies.

D. Excavation and backfill shall be as specified in the Earthwork section of the Architectural Specifications.

3.4 ACCESSIBILITY

A. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to motors, controllers, switchgear, junction boxes, etc. If required for better accessibility, furnish access door for this purpose. Minor deviations from Drawings may be made to allow for better accessibility, but any change must be noted and approved by the Architect before proceeding with the work.

B. It shall be the responsibility of the trade installing any concealed equipment needing access to provide access panels for each item requiring service. Access panels shall be coordinated with the material in which it shall be installed. Access panels are specified in the Architectural section.

C. Access panels shall be provided where shown on the Drawings and otherwise where required for service of equipment. All required locations for access panels not shown on Drawings shall be submitted by the Contractor to the Architect for review. No access panels shall be installed until its location is reviewed and accepted by the Architect. The Contractor shall make reasonable modifications to his work in order to provide acceptable access panel locations.

D. Wherever access is required through walls or ceilings to motors, controllers, pull boxes, or other concealed equipment installed under this Division, the Contractor shall provide a hinged access door and frame as follows:
1. Drywall construction - Milcor Style AT, or as approved by Architect, with drywall insert and casing beads.
2. Finished acoustical tile ceiling - Milcor Style AT, or as approved by Architect.
3. Finished plaster ceiling - Milcor Style AP, or as approved by Architect.
4. Finished plaster walls or ceramic tile - similar to doors required for finished acoustical tile ceiling.
5. Access doors shall be "B" label fire construction where required.

3.5 EQUIPMENT NOISE AND VIBRATION

A. It is the intention to specify and for the Contractor to provide equipment and systems that, as defined herein, shall be quiet and free of apparent vibration in operation.

B. It is intended that vibration shall not be apparent to the senses in occupied areas of the building. To this end, both the balancing of rotating machinery and the installation of vibration isolation at various locations are required.

C. It shall be the responsibility of the Contractor to obtain equipment that is quiet in operation as compared to other available equipment of this size, capacity, and type; to install equipment so that a minimum amount of noise and/or vibration is transmitted to the building.

D. Any additional precautions deemed necessary to provide a quiet installation shall be done as part of the work of the Contractor, subject to review by the Engineer and without additional cost to the Owner. After the system is in operation, it shall be the responsibility of the Contractor to make any changes to equipment or work installed that may be required to provide a system which is quiet in operation as defined herein.

E. The system noise level shall be equal to or less than NC40.

3.6 LUBRICATION

A. Provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a lubrication tube with suitable fitting to an accessible location and suitably identify it.

B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated with a lubricant recommended by the equipment manufacturer, until the Owner issues a certificate of substantial completion for the equipment, item or system.

3.7 ELECTRICAL CONNECTIONS

A. General:
   1. The Contractor shall familiarize himself with all sections of these Specifications in order to provide necessary electrical connections to all equipment. Such equipment shall be connected, complete, and ready for operation in accordance with manufacturer's recommendations. Where such connections are made using a receptacle and cap, the necessary pigtail shall be provided.
   2. Safety disconnect switches shall be provided for all motors or equipment as required by the N.E.C. whether shown on the Drawings or not.
   3. Temperature control wiring in general shall be installed under the section specifying the equipment, unless specifically indicated on the Electrical Drawings. Under this section, power shall be provided where indicated to serve such systems as indicated.
   4. Individual temperature control devices, such as thermostats which directly control unit heaters, float switches, etc., shall be supplied and connected under the section specifying the equipment.
   5. The electrical subcontractor shall provide all wiring, with the exception of the following.
      a. Equipment control wiring, except for smoke control.
      b. Interlock wiring.
   6. Provide all power wiring complete from power source to motor or equipment junction box, including power wiring through starters. Install all starters not factory mounted on

equipment.

7. All control, signal, interlock, and equipment control wiring, regardless of voltage, shall be installed in raceway system unless specifically indicated or specified otherwise.
8. Provide all fire alarm system and smoke control wiring, regardless of voltage. Install in separate raceway systems as specifically specified in the fire alarm system section.
9. Provide all power connections for heat-taped equipment and piping and extend proper connections to locations coordinated with supplier.

3.8 FIELD OBSERVATIONS

A. Work identified as requiring corrective action by the Contractor is considered not to be in compliance with the Contract Documents.
   1. The Contractor shall provide prompt written notice to the Architect outlining what remedial measures are to be taken to correct each noted deficiency and the date the corrective action will be available for re-examination.
   2. The Contractor is responsible for scheduling remedial work in a timely fashion so that the corrected work may be re-examined. Uncovering work for the purpose of checking corrective actions will be at the cost of the Contractor regardless of the acceptability of the remedial work.
   3. The Contractor shall provide the Architect a minimum of five regular working days notice, exclusive of transmittal time, of the date corrective action is available for re-examination.

3.9 OPERATING INSTRUCTIONS

A. The Contractor shall provide the services of a factory trained specialist to supervise the start-up of all equipment specified in this Division and to instruct the Owner's operators for 2 - 8-hour day(s) operating instruction period. The operating instruction period shall cover all major Division 26 and 28 equipment and all Division 26 and 28 systems and be defined as straight time working hours and shall not include nights, weekends, or travel time to and/or from the project. See individual Sections for additional instructions required of Manufacturer's trained specialists.

B. All instruction periods shall be video taped by the Contractor in digital format. Upon completion of all instruction periods, Contractor shall provide record video files to the Owner.

C. The Owner shall be notified in writing at least five days before each operating instruction period begins. The Contractor shall commence no instruction period until the Owner has issued his written acceptance of the starting time.

D. At the conclusion of the operating instruction period(s) the Contractor shall submit to the Owner a separate certification letter signed by each instructor identifying the system and/or equipment covered in the instruction period, the duration, and that the equipment was in proper operating condition at the time of the instructions. The Owner or his authorized representative shall counter-sign these certifications attesting to the completeness of the instruction period and shall forward copies of the counter-signed certificate to the Architect for his files.

3.10 OPERATING AND MAINTENANCE MANUALS

A. The Contractor shall provide operating instructions and maintenance data manuals for each specific item of equipment and materials provided under this Division.

B. Submit operating and maintenance data manuals for review at least four weeks before systems' start-up. Assemble all data in a completely indexed three-ring binder(s).

C. Maintenance manuals shall include the minimum following information. Refer to individual sections of this Division for specific additional requirements.
   1. Identifying name and Contract Document designation.
   2. Equipment section shall include corrected copies of all product data submittals manufacturer operations, parts manuals and written maintenance instructions for each individual piece of equipment.
   3. Local source for parts and service.
   4. Locations (where several similar items are used, provide a list).
   5. Complete nameplate data.
   6. Complete lubrication, cleaning, and servicing data.
   7. Parts lists with diagrams.
   8. Wiring diagrams.
   9. Troubleshooting guides.
   10. Manufacturer's recommended operating and maintenance instructions with all non-applicable information deleted.
   11. Panel schedules (8 1/2 x 11 copies)

3.11 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the project site a complete set of "Record Drawings" reflecting an accurate as-built record of all Work. In addition, the "Record Drawings" shall be marked to show the precise location of hidden-from-view work and equipment, including, but not limited to, concealed or embedded raceways, junction boxes, pull-boxes, and all changes and deviations in the Work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite instructions from the Architect.
   1. The "Record Drawings" shall consist of a complete set of the Contractor's quality control submittals.
   2. The Contractor shall utilize the Division 26 Contract Drawings as the basis for Record Drawings of that portion of the Work where no submittals were required, (i.e., equipment schedules, schematics, etc.). All references to member firms of the design team shall be blacked-out on Contract Drawings used for Record Drawings.
   3. The Contractor is responsible for all reproduction costs associated with Record Drawings.
   4. Drawings shall show all conduit paths (1-1/2" and larger unless specified otherwise) with installation details included and all raceways labeled as to use.
   5. All work outside the limits of the building shall show exact location and depth below grade of all raceways, duct banks and direct buried cables.

B. Record dimensions shall clearly and accurately delineate all Division 26 and 28 base building and tenant Work provided; locations shall be suitably identified by at least two dimensions to permanent structures.

C. The Contractor shall mark all "Record Drawings" on the front lower right hand corner with a rubber stamp impression that states the following:

   "RECORD DRAWINGS. To be used for recording Field Deviations and Dimensional Data Only."

D. Upon completion of work, the Contractor shall certify the "Record Drawings" for correctness by providing and signing the following certification:

   "CERTIFIED CORRECT

   (Name of Contractor)

By:

Date:

(Name of Electrical Subcontractor)

By:

Date: "

E. Prior to testing of the Work of this Division, the Contractor shall forward properly certified reproducible "Record Drawings" to the Architect as a quality control submittal in accordance with the requirements of paragraph 1.15 of this Section.

3.12 START-UP

A. At a time designated by the Owner, all Work provided by Division 26 and 28 shall be operated by the Contractor to demonstrate to the Owner compliance with the Contract Documents. The Contractor shall provide all materials, test equipment, utilities, etc., and sufficient responsible and knowledgeable personnel from each related trade as required to demonstrate proper systems' operation.
   1. This start-up test shall be in addition to the requirements for Contractor tests, Code officials inspection tests and operating instructions.
   2. The Contractor shall supervise, conduct, and document the start-up tests.
   3. The date for the start-up tests shall be prior to the anticipated date of Substantial Completion and in sufficient time to permit proper and full execution of the tests prior to that date. Any adjustments and/or alterations which the start-up tests indicate as necessary for the proper functioning of all equipment shall be completed prior to the date of Substantial Completion.
   4. The Contractor shall provide a detailed schedule of completion indicating when each system is to be completed and outlining when and how tests will be performed. Completion schedule and test procedures shall be submitted for review at least 60 days prior to the anticipated date of system start-up.

B. All Division 26 systems shall be operated properly with loads balanced among phases and controls adjusted. All labels shall be removed and the lighting fixtures shall be clean and in operating condition.
   1. Work found not operating in accordance with the requirements specified in the Contract Documents shall be corrected and additional start-up tests made, all at no additional cost to the Owner.

C. The Contractor shall submit to the Architect certificates and documents required herein at least sixty days prior to the start-up tests, unless specified otherwise.
   1. The Code Authority must have signed off for final approval and occupancy of project.
   2. All system tests as required by this Division must be performed and accepted.
   3. Provide test reports, as contract closeout submittal type, as required by Section Specification work for the following electrical systems.
      a. Grounding System.
      b. Fire Alarm System.
      c. Wire and Cable.
      d. Telephone and data systems.
   4. O&M manuals submitted.
   5. Record (AS-Built) drawings submitted.
   6. On-site operating instructions and factory start-up complete and specified documentation submitted.

7. Thorough cleaning of all systems, equipment and spaces.
8. All systems identification complete.
9. All electrical connections complete and free from short circuits.
10. All Field Report and Punch List work complete.

END OF SECTION

SECTION 260100 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Supporting devices for electrical components.
   2. Electrical identification.
   3. Electricity-metering components.
   4. Concrete equipment bases.
   5. Electrical demolition.
   6. Cutting and patching for electrical construction.
   7. Touchup painting.

1.3 SUBMITTALS

A. Product Data: For electricity-metering equipment.

B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
   1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors." Coordinate this work with the Architect.

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

2.2 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.

2. Color: Black letters on orange background.
3. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).

D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend that indicates type of underground line.

E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.

H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6-mm) grommets in corners for mounting.

J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

A. Coordination: Coordinate all utility company requirements with the utility company prior to installation.

B. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

C. Meter Sockets: Comply with requirements of electrical power utility company.

D. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses. Coordinate cold- or hot-sequencing with utility company
1. Housing: NEMA 250, Type 1enclosure .
2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 22,000-A interrupting capacity, minimum.

2.4 CONCRETE BASES

A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete ."

B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

2.5 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
   6. Steel: Welded threaded studs or spring-tension clamps on steel.
      a. Field Welding: Comply with AWS D1.1.
   7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   8. Light Steel: Sheet-metal screws.
   9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and cables with color banding as follows:
   1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
   3. Colors: As follows:
      a. Fire Alarm System: Red.

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common

G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
   1. Phase A: Black.
   2. Phase B: Red.
   3. Phase C: Blue.
   4. Neutral: White
   5. Ground: Green
   6. Isolated Ground: Yellow and Green

H. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

I. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.5 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.6 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation

requirements are specified in Division 7 Section "Firestopping."

3.7 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.8 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.9 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
   1. Supporting devices for electrical components.
   2. Electrical identification.
   3. Electricity-metering components.
   4. Concrete bases.
   5. Cutting and patching for electrical construction.
   6. Touchup painting.

3.10 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 260200 - SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF THE WORK

A. Provide the electrical service entrance and conduit/duct bank requirements as shown on the drawings and specified.

1.3 STANDARDS

A. Coordinate all work for electric service with the local power company servicing the Project and provide service entrance duct banks, pads, racking and conductors to the transformer to their standards and regulations.

1.4 SUBMITTALS

A. Quality Control Submittals:
   1. Service and equipment shop drawings showing the arrangement in plan and elevation of all metering, and main service equipment duct banks.
   2. Drawings shall include manufacturer's name, ratings, physical dimensions, electrical ratings and all other pertinent layout information to include verification of clearance in designated room or space.

B. Contract Closeout Submittals:
   1. Record drawings
   2. Documentation of inspections by, and tests performed for the Authority Having Jurisdiction.

PART 2 – REQUIREMENTS

2.1 MANUFACTURERS

A. Basis of Design: Square D Company.

B. Acceptable Manufacturers: If it complies with these specifications, products by the following manufacturers will be acceptable.
   1. Siemens Energy and Automation
   2. Eaton Corporation: Cutler-Hammer Products

C. Substitutions are not permitted.

2.2 ELECTRIC SERVICE

A. Provide electric service as shown on the drawings and as specified.

B. Electric Service Costs:
   1. The contractor shall provide all fees, labor and materials associated with bringing service to the facility.

C. Main Service Equipment:
   1. Provide main service equipment of the size and type indicated on the drawings, this equipment shall bear a UL label for service entrance equipment.
   2. Confirm available short circuit current from the utility company and provide all service equipment with AIC ratings that exceed the available short circuit current at the particular pieces of equipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Check all shop drawings provided to ensure all work required to be performed by the Contractor meets all requirements.

3.2 CLEANING

A. Clean all dirt and debris from the inside of all raceways for service entrance cables.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Nonmetallic-sheathed cable.

C. Underground feeder and branch-circuit cable.

D. Service entrance cable.

E. Armored cable.

F. Metal-clad cable.

G. Wiring connectors.

H. Electrical tape.

I. Heat shrink tubing.

J. Oxide inhibiting compound.

K. Wire pulling lubricant.

L. Cable ties.

M. Firestop sleeves.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

E. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.

F. Section 312316 - Excavation.

G. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

H. Section 312323 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).

E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2021).

F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy Wire for Subsequent Covering of Insulation; 2018.

G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.

H. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

J. FM 3971 - Fire Protective Coatings and Wraps for Grouped Cables; 2019.

K. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; 2008a (Validated 2019).

L. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable; 2004 (Corrigendum 2014).

M. IEEE 383 - IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities; 2015.

N. IEEE 1210 - IEEE Standard Tests for Determining Compatibility of Cable-Pulling Lubricants with Wire and Cable; 2004 (Corrigendum 2014).

O. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

P. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.

Q. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.

R. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.

S. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.

T. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

U. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

V. UL 4 - Armored Cable; Current Edition, Including All Revisions.

W. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

X. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

Y. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.

Z. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

AA. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

BB. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

CC. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.

DD. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

EE. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.

FF. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.

GG. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
   3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

C. Wire Pulling Lubricant: Certification of compatibility with conductors/cables where used with the following insulation/jacket types:

D. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For branch circuit wiring in dry locations permitted to be of Types III, IV, and V construction.
   2. In addition to other applicable restrictions, may not be used:
      a. Where exposed to view.
      b. Where exposed to damage.
      c. For damp, wet, or corrosive locations.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For underground service entrance, installed in raceway.

F. Armored cable is permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
         1) Maximum Length: 6 feet (1.8 m).

b. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.

2. In addition to other applicable restrictions, may not be used:
   a. Unless approved by Owner.
   b. Where not approved for use by the authority having jurisdiction.
   c. Where exposed to view.
   d. Where exposed to damage.
   e. For damp, wet, or corrosive locations.

G. Metal-clad cable is permitted only as follows:
1. Where not otherwise restricted, may be used:
   a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      1) Maximum Length: 6 feet (1.8 m).
   b. Where concealed in hollow stud walls and above accessible ceilings for branch circuits up to 20 A.
2. In addition to other applicable restrictions, may not be used:
   a. Unless approved by Owner.
   b. Where not approved for use by the authority having jurisdiction.
   c. Where exposed to view.
   d. Where exposed to damage.
   e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Comply with FS A-A-59544 where applicable.

G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

I. Conductors for Grounding and Bonding: Also comply with Section 260526.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:
1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless

specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.

a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
   1) Services: Copper conductors size 1/0 AWG and larger.
b. Where aluminum conductors are substituted for copper, comply with the following:
   1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
   2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
   3) Provide aluminum equipment grounding conductor sized according to NFPA 70.
   4) Equip electrical distribution equipment with compression lugs for terminating aluminum conductors.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.
4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

M. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
   a. Exceptions:
      1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
      2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
      3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.

N. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

O. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
   a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
3. Color Code:
   a. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   b. Equipment Ground, All Systems: Green.
   c. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
1. Copper Building Wire:
   a. Cerro Wire LLC: www.cerrowire.com/#sle.
   b. Encore Wire Corporation: www.encorewire.com/#sle.
   c. General Cable Technologies Corporation: www.generalcable.com/#sle.
   d. Service Wire Co: www.servicewire.com/#sle.
   e. Southwire Company: www.southwire.com/#sle.
   f. Substitutions: See Section 016000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.
   2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.
      c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.

2.4 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

2.5 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Service Wire Co: www.servicewire.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.6 SERVICE ENTRANCE CABLE

A. Manufacturers:
   1. Copper Service Entrance Cable:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. Service Wire Co: www.servicewire.com/#sle.
      d. Southwire Company: www.southwire.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Aluminum Service Entrance Cable:
      a. Encore Wire Corporation: www.encorewire.com/#sle.
      b. General Cable Technologies Corporation: www.generalcable.com/#sle.
      c. Southwire Company: www.southwire.com/#sle.
      d. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

B. Service Entrance Cable for Above-Ground Use: NFPA 70, Type SE multiple-conductor cable listed and labeled as complying with UL 854, Style R.

C. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

D. Conductor Stranding: Stranded.

E. Insulation Voltage Rating: 600 V.

2.7 ARMORED CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN.

F. Grounding: Combination of interlocking armor and integral bare bonding wire.

G. Armor: Steel, interlocked tape.

2.8 METAL-CLAD CABLE

A. Manufacturers:
   1. AFC Cable Systems Inc: www.afcweb.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Service Wire Co: www.servicewire.com/#sle.
   4. Southwire Company: www.southwire.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.

F. Provide oversized neutral conductors where indicated or required.

G. Provide dedicated neutral conductor for each phase conductor where indicated or required.

H. Grounding: Full-size integral equipment grounding conductor.

I. Armor: Steel, interlocked tape.

J. Provide PVC jacket applied over cable armor.

2.9 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
   3. Connectors for Aluminum Conductors: Use compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   5. Aluminum Conductors: Use compression connectors for all connections.

6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
7. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Ideal Industries, Inc: www.idealindustries.com/#sle.
c. NSI Industries LLC: www.nsiindustries.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

H. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
a. Burndy LLC: www.burndy.com/#sle.
b. Ilsco: www.ilsco.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

2.10 ACCESSORIES

A. Electrical Tape:
1. Manufacturers:
a. 3M: www.3m.com/#sle.
b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266

degrees F (130 degrees C) overload service.

5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil (3.2 mm); suitable for continuous temperature environment up to 176 degrees F (80 degrees C).
6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil (0.18 mm); suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Burndy LLC: www.burndy.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. Ilsco: www.ilsco.com/#sle.

D. Wire Pulling Lubricant:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. American Polywater Corporation: www.polywater.com/#sle.
      c. Ideal Industries, Inc: www.idealindustries.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Listed and labeled as complying with UL 267.
   3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   4. Suitable for use at installation temperature.
   5. Products:
      a. American Polywater Corporation; Polywater J Cable Pulling Lubricant: www.polywater.com/#sle.
      b. American Polywater Corporation; Polywater LZ Cable Pulling Lubricant: www.polywater.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.
   1. Manufacturers:
      a. Burndy LLC; _____: www.burndy.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
   1. Products:
      a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
   1. Products:
      a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

H. Fire-Protective Coating for Electrical Conductors and Cables: Field-applied, intumescent or ablative coating designed to prevent ignition and propagation of fire along thermoplastic-insulated conductors and cables.
   1. Pass flammability tests of one of the following:
      a. ASTM E84, Class A; maximum flame spread index of 25.
      b. FM 3971.
      c. IEEE 383.
   2. Products:
      a. Vimasco Corporation; CharCoat CC Cable Coating: www.charcoat.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.

a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
b. Increase size of conductors as required to account for ampacity derating.
c. Size raceways, boxes, etc. to accommodate conductors.

7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
8. Provide oversized neutral/grounded conductors where indicated.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.

F. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.

G. Install armored cable (Type AC) in accordance with NECA 120.

H. Install metal-clad cable (Type MC) in accordance with NECA 120.

I. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

J. Exposed Cable Installation (only where specifically permitted):
1. Route cables parallel or perpendicular to building structural members and surfaces.
2. Protect cables from physical damage.

K. Direct Burial Cable Installation:
1. Provide trenching and backfilling in accordance with Section 312316 - Excavation and Section 312323 - Fill.
2. Install cable with minimum cover of 24 inches (610 mm) unless otherwise indicated or required.
3. Protect cables from damage in accordance with NFPA 70.
4. Provide underground warning tape in accordance with Section 260553 along entire cable length.

L. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

M. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

N. Terminate cables using suitable fittings.
   1. Armored Cable (Type AC):
      a. Use listed fittings and anti-short, insulating bushings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
   2. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
      c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

O. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

P. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet (1.5 m) of slack.

Q. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

R. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

S. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

T. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
      b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
   3. Wet Locations: Use heat shrink tubing.

U. Insulate ends of spare conductors using vinyl insulating electrical tape.

V. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

W. Identify conductors and cables in accordance with Section 260553.

X. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

Y. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

F. Chemically-enhanced ground electrodes.

G. Ground plate electrodes.

H. Ground enhancement material.

I. Ground access wells.

1.2 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

C. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

D. Section 337900 - Site Grounding.

1.3 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 99 - Health Care Facilities Code; 2018.

G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Field quality control test reports including test procedure used; test result that comply with requirements; and result of failed tests and corrective action taken to achieve test results that compy with requirements.

E. Qualifications Data for firms and persons specified in "Quality Assurance" Article.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Apache Grounding/Erico Inc.
      b. Boggs, Inc.
      c. Chance/Hubbell.
      d. Copperweld Corp.
      e. Dossert Corp.

f. Erico Inc.; Electrical Products Group.
g. Framatome Connectors/Burndy Electrical.
h. Galvan Industries, Inc.
i. Harger Lightning Protection, Inc.
j. Hastings Fiber Glass Products, Inc.
k. Heary Brothers Lightning Protection Co.
l. Ideal Industries, Inc.
m. ILSCO.
n. Kearney/Cooper Power Systems.
o. Korns: C. C. Korns Co.; Division of Robroy Industries.
p. Lightning Master Corp.
q. Lyncole XIT Grounding.
r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
s. Raco, Inc.; Division of Hubbell.
t. Robbins Lightning, Inc.
u. Salisbury: W. H. Salisbury & Co.
v. Superior Grounding Systems, Inc.
w. Thomas & Betts, Electrical.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-

to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode stranded cable conductors without splice or joint. underground conductors shall be bare, tinned, starnded type unless otherwise noted.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   4. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   5. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode as needed..
   6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
   7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
      a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
      b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

F. Service-Supplied System Grounding:
   1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
   2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

G. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide green insulated insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
8. Provide bonding for metal building frame.
9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
10. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
11. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

H. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and leave slack conductor for termination by others.
   a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
   b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.

I. Pole-Mounted Luminaires: Also comply with Section 265600.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
   a. Exceptions:
      1) Use bare copper conductors where installed underground in direct contact with earth.
      2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    a. Exceptions:
        1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
    a. Exceptions:
        1) Use exothermic welded connections for connections to metal building frame.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper bonded.
3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.
4. Where rod lengths of greater than 10 feet (3.0 m) are indicated or otherwise required, sectionalized ground rods may be used.

F. Chemically-Enhanced Ground Electrodes:
1. Description: Copper tube factory-filled with electrolytic salts designed to provide a low-impedance ground in locations with high soil resistivity; straight (for vertical installations) or L-shaped (for horizontal installations) as indicated or as required.
2. Length: 10 feet (3.0 m).
3. Integral Pigtail: Factory-attached, sized not less than grounding electrode conductor to be attached.
4. Backfill Material: Grounding enhancement material recommended by electrode manufacturer.

G. Ground Enhancement Material:
1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.

H. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
    a. Round Wells: Not less than 8 inches (200 mm) in diameter.
    b. Rectangular Wells: Not less than 12 by 12 inches (300 by 300 mm).
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches (250 mm).
4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

D. In raceways, use insulated equipment grounding conductors.

E. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

F. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

G. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

H. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

I. Underground Grounding Conductors: Use [tinned-] copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.3 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Istall insulated equipment grounding conductor with circuit conductors for the following items, in addiiton to those required by the NEC:
   1. Feeders and branch circuits
   2. LIghting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.

D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on

busway.

E. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.4 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

B. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 2 inches below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 2 inches of top of rod exposed.

D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

F. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each

end.

G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

H. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

I. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

J. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

K. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

L. For all projects located within the State of New Jersey, bond foundation rebar to grounding electrode system per New Jersey DCA Bulletin No. 02-2 using a clamp listed for the purpose (Blackburn #JDLI or approved listed equal). The bonding point shall remain exposed until installation is inspected and approved by the building code official.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A [and UL 486B].

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

I. Make grounding and bonding connections using specified connectors.

J. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

K. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

L. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

M. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

N. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Identify grounding and bonding system components in accordance with Section 260553.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

G. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:

H. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

I. Testing: Perform the following field quality-control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
   3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
      a. Equipment Rated 500 kVA and Less: 10 ohms.
   4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

C. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.

D. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

E. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

F. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

G. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
a. NFPA 70.
b. Applicable building code.
c. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Components for Vibration Isolation and/or Seismic Controls: See Section 260548.

C. Materials for Metal Fabricated Supports: See Section 055000.

D. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Manufacturers:
    a. ABB: www.electrification.us.abb.com/#sle.
    b. Eaton Corporation: www.eaton.com/#sle.
    c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
    d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
    e. nVent; Caddy: www.nvent.com/#sle.
    f. Substitutions: See Section 016000 - Product Requirements.
2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
3. Conduit Clamps: Bolted type unless otherwise indicated.
4. Products:
    a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
    b. Gripple, Inc; Fast Trak: www.gripple.com/#sle.
    c. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
    d. Gripple, Inc; Low Profile Bracket Kits: www.gripple.com/#sle.
    e. Substitutions: See Section 016000 - Product Requirements.

E. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
1. Manufacturers:
    a. ABB: www.electrification.us.abb.com/#sle.
    b. Eaton Corporation: www.eaton.com/#sle.
    c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
    d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
    e. nVent; Caddy: www.nvent.com/#sle.
    f. Substitutions: See Section 016000 - Product Requirements.

F. Metal Channel/Strut Framing Systems:
1. Manufacturers:
    a. ABB: www.electrification.us.abb.com/#sle.
    b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
    c. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
    d. Eaton Corporation: www.eaton.com/#sle.
    e. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
    f. Substitutions: See Section 016000 - Product Requirements.
    g. Source Limitations: Furnish channel/strut and associated fittings, accessories, and hardware produced by single manufacturer.
2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
3. Comply with MFMA-4.
4. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.

5. Channel Material:
   a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
6. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
7. Minimum Channel Dimensions: 1-5/8 inch (41 mm) wide by 13/16 inch (21 mm) high.

G. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2-inch (13 mm) diameter.
   b. Busway Supports: 1/2-inch (13 mm) diameter.
   c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.
   d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
   e. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
   f. Outlet Boxes: 1/4-inch (6 mm) diameter.
   g. Luminaires: 1/4-inch (6 mm) diameter.

H. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
   a. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
   b. Eaton Corporation: www.eaton.com/#sle.
   c. Green Link, Inc: www.greenlinkengineering.com/#sle.
   d. nVent; Caddy: www.nvent.com/#sle.
   e. PHP Systems/Design: www.phpsd.com/#sle.
2. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.

I. Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
   a. Dewalt: anchors.dewalt.com/#sle.
   b. Hilti, Inc: www.hilti.com/#sle.
   c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
   d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.
2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
5. Hollow Masonry: Use toggle bolts.
6. Hollow Stud Walls: Use toggle bolts.
7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
8. Sheet Metal: Use sheet metal screws.
9. Wood: Use wood screws.
10. Plastic and lead anchors are not permitted.
11. Powder-actuated fasteners are not permitted.
12. Hammer-driven anchors and fasteners are permitted only as follows:
   a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
   b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
13. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
b. Comply with MFMA-4.
c. Channel Material: Use galvanized steel.
d. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm) minimum base metal thickness.

14. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Provide required vibration isolation and/or seismic controls; see Section 260548.

I. Field Welding, Where Approved by Architect: See Section 055000.

J. Equipment Support and Attachment:
1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 3 inches (80 mm) in height; see Section 033000.
5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

K. Conduit Support and Attachment: See Section 260533.13 for additional requirements.

L. Box Support and Attachment: See Section 260533.16 for additional requirements.

M. Interior Luminaire Support and Attachment: See Section 265100 for additional requirements.

N. Exterior Luminaire Support and Attachment: See Section 265600 for additional requirements.

O. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

P. Secure fasteners in accordance with manufacturer's recommended torque settings.

Q. Remove temporary supports.

R. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 260533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Galvanized steel intermediate metal conduit (IMC).

B. PVC-coated galvanized steel rigid metal conduit (RMC).

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Galvanized steel electrical metallic tubing (EMT).

F. Stainless steel electrical metallic tubing (EMT).

G. Rigid polyvinyl chloride (PVC) conduit.

H. Electrical nonmetallic tubing (ENT).

I. Liquidtight flexible nonmetallic conduit (LFNC).

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete encasement of conduits.

B. Section 078400 - Firestopping.

C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Cable assemblies consisting of conductors protected by integral metal armor.

D. Section 260526 - Grounding and Bonding for Electrical Systems.
   1. Includes additional requirements for fittings for grounding and bonding.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260533.16 - Boxes for Electrical Systems.

G. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

I. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

J. Section 312316 - Excavation.

K. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

L. Section 312323 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2015.

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2015.

C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.

D. ASTM D1002 - Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal); 2010 (Reapproved 2019).

E. ASTM D1598 - Standard Test Methods for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure; 2021.

F. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings; 2018.

G. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.

H. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing; 2016.

I. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing; 2016a (Reapproved 2022).

J. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); 2016.

K. ASTM F2176 - Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Innerduct; 2017.

L. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

M. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.

N. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.

O. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

P. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2018.

Q. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.

R. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2016.

S. NEMA TC 7 - Solid-Wall Coilable and Straight Electrical Polyethylene Conduit; 2021.

T. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014.

U. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.

V. NEMA TC 14.AG - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; 2015.

W. NEMA TC 14.BG - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; 2015.

X. NEMA TC 14.XW - Extra Heavy Wall Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; 2015.

Y. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

AA. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

BB. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

CC. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

DD. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

EE. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

FF. UL 651A - Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.

GG. UL 746C - Polymeric Materials – Use in Electrical Equipment Evaluations; Current Edition, Including All Revisions.

HH. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

II. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

JJ. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

KK. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

LL. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

MM. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

NN. UL 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

OO. UL 2515A - Standard for Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
   4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
   5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

C. Project Record Documents: Record actual routing for conduits installed underground and conduits 2-inch (53 mm) trade size and larger.

1.6 DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

B. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use rigid PVC conduit.

3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to heavy wall galvanized steel electrical metallic tubing (EMT) painted with a minimum of two coats of bitumatic paint where in contact with and emerging from underground.
5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.

D. Concealed Within Masonry Walls: Use galvanized steel electrical metallic tubing (EMT).

E. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).

F. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
1. Locations subject to physical damage include, but are not limited to:
a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.

G. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).

H. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Electrical Service Conduits: See Section 262100 for additional requirements.

C. Fittings for Grounding and Bonding: See Section 260526 for additional requirements.

D. Provide conduit, fittings, supports, and accessories required for complete raceway system.

E. Provide products listed, classified, and labeled as suitable for purpose intended.

F. Minimum Conduit Size, Unless Otherwise Indicated:
1. Branch Circuits: 3/4-inch (21 mm) trade size.
2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
3. Control Circuits: 3/4-inch (21 mm) trade size.
4. Underground, Interior: 1-inch-inch (27 mm mm) trade size.
5. Underground, Exterior: 1-inch (27 mm) trade size.

G. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular.com/#sle.
3. Rymco USA: www.rymcousa.com/#sle.

4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
1. Manufacturers:
a. ABB; T&B: www.electrification.us.abb.com/#sle.
b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
c. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
3. Material: Use steel or malleable iron.
a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).

C. PVC-Coated Boxes and Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
3. Material: Use steel or malleable iron.
4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

C. Fittings:
1. Manufacturers:
a. ABB; T&B: www.electrification.us.abb.com/#sle.
b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use fittings specifically designed for this conduit for the location where it is installed.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
2. Electri-Flex Company: www.electriflex.com/#sle.
3. International Metal Hose: www.metalhose.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
1. Manufacturers:
a. ABB; T&B: www.electrification.us.abb.com/#sle.
b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use fittings specifically designed for this conduit for the location where it is installed.

2.7 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
2. Nucor Tubular Products: www.nucortubular/#sle.
3. Rymco USA: www.rymcousa.com/#sle.
4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
1. Manufacturers:
a. ABB; T&B: www.electrification.us.abb.com/#sle.
b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use zinc coated steel.
4. Connectors and Couplings: Use zinc coated steel and insulated throat. Provide compression type up to 2-inches and for 2 1/2-inch conduit and larger, set screw fittings and compression fittings are acceptable .

2.8 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.

B. Fittings:
   1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   2. Connectors and Couplings: Use compression/gland or set-screw type.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. ABB; Carlon: www.carlon.com/#sle.
   2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
   3. Cantex Inc: www.cantexinc.com/#sle.
   4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
   5. JM Eagle: www.jmeagle.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
   1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.
   3. IPEX, a division of Aliaxis: www.ipexna.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

2.11 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch (0.51 mm).

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).

E. Foam Conduit Sealant:
   1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
   2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
   3. Rated to hold minimum of 10 ft (3.0 m) water head pressure.
   4. Products:
      a. American Polywater Corporation; Polywater AFT Foam Duct Sealant: www.polywater.com/#sle.
      b. American Polywater Corporation; Polywater FST Foam Duct Sealant: www.polywater.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

F. Conduit Mechanical Seals:
   1. Listed as complying with UL 514B.
   2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
   3. Suitable for sealing around conductors/cables to be installed.
   4. Products:
      a. American Polywater Corporation; PHRD SG Mechanical Seals: www.polywater-haufftechnik.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

G. Sealing Systems for Concrete Penetrations:
   1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
   2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
   3. Products:
      a. American Polywater Corporation; PZVR Cement-Coated Concrete Wall Sleeves: www.polywater-haufftechnik.com/#sle.
      b. American Polywater Corporation; PHSD Mechanical Seals: www.polywater-haufftechnik.com/#sle.
      c. American Polywater Corporation; PHSI 150 Varia Double Wall Inserts: www.polywater-haufftechnik.com/#sle.
      d. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

H. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
   1. Products:
      a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: www.altaproductsllc.com/#sle.
      b. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
      c. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.

d. Substitutions: See Section 016000 - Product Requirements.

I. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
1. Products:
a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
1. Products:
a. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that mounting surfaces are ready to receive conduits.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.

D. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.

E. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.

F. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

G. Electrical Nonmetallic Tubing (ENT): Install in accordance with NECA 111.

H. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.

I. Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
a. Electrical rooms.
b. Mechanical equipment rooms.
c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
a. Across floors.
b. Across roofs.

c. Across top of parapet walls.
d. Across building exterior surfaces.

6. Conduits installed underground may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.
14. Group parallel conduits in same area on common rack.

J. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
2. Provide required vibration isolation and/or seismic controls; see Section 260548.
3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
5. Use conduit strap to support single surface-mounted conduit.
    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
6. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
8. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.
11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

K. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, extend 6-inches above finished floor with cap.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

L. Penetrations:
   1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
   2. Make penetrations perpendicular to surfaces unless otherwise indicated.
   3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
   4. Conceal bends for conduit risers emerging above ground.
   5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
   6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
   7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
   8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

M. Underground Installation:
   1. Provide trenching and backfilling; see Section 312316 and Section 312323.

N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated; see Section 033000.

O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
   3. Where conduits are subject to earth movement by settlement or frost.

P. Conduit Sealing:
   1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
      a. Where conduits enter building from outside.
      b. Where service conduits enter building from underground distribution system.
      c. Where conduits enter building from underground.
      d. Where conduits may transport moisture to contact live parts.
   2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
      a. Where conduits pass from outdoors into conditioned interior spaces.
      b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

Q. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.

R. Provide grounding and bonding; see Section 260526.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 260533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Floor boxes.

E. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

B. Section 078400 - Firestopping.

C. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.

D. Section 260526 - Grounding and Bonding for Electrical Systems.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260533.13 - Conduit for Electrical Systems:
   1. Conduit bodies and other fittings.
   2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

G. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

H. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

I. Section 262726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.

D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

J. UL 508A - UL Standard for Safety Industrial Control Panels; 2018.

K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, and floor boxes.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use cast iron boxes, cast aluminum boxes, or _____ where exposed galvanized steel rigid metal conduit, exposed intermediate metal conduit (IMC), or _____ is used.
   4. Use nonmetallic boxes where exposed rigid PVC conduit is used.
   5. Use suitable concrete type boxes where flush-mounted in concrete.
   6. Use suitable masonry type boxes where flush-mounted in masonry walls.
   7. Use raised covers suitable for the type of wall construction and device configuration where required.
   8. Use shallow boxes where required by the type of wall construction.
   9. Do not use "through-wall" boxes designed for access from both sides of wall.
   10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   12. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
   13. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   14. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   15. Wall Plates: Comply with Section 262726.
   16. Manufacturers:
       a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
       b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
       c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
       d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
       e. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
      a. Indoor Clean, Dry Locations: Type 1, painted steel.
      b. Outdoor Locations: Type 3R, painted steel.
   3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   4. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D. Floor Boxes:
   1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
   2. Use cast iron or nonmetallic floor boxes within slab on grade.
   3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
   4. Manufacturer: Same as manufacturer of floor box service fittings.

2.2 ACCESSORIES

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
   1. Manufacturers:
      a. Quickflash Weatherproofing Products, Inc: www.quickflashproducts.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that mounting surfaces are ready to receive boxes.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, _____.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
   2. Unless dimensioned, box locations indicated are approximate.
   3. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
   4. Locate boxes so that wall plates do not span different building finishes.
   5. Locate boxes so that wall plates do not cross masonry joints.
   6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
   8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
      a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
   9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
   10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
      a. Concealed above accessible suspended ceilings.
      b. Within joists in areas with no ceiling.
      c. Electrical rooms.
      d. Mechanical equipment rooms.

I. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
   4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
   1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
   2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
   3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.

O. Underground Boxes/Enclosures:
   1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
   2. Flush-mount enclosures located in concrete or paved areas.
   3. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

P. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

R. Close unused box openings.

S. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

T. Provide grounding and bonding in accordance with Section 260526.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

E. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 099113 - Exterior Painting.

B. Section 099123 - Interior Painting.

C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

D. Section 260573 - Power System Studies: Arc flash hazard warning labels.

E. Section 262300 - Low-Voltage Switchgear: Factory-installed mimic bus.

1.3 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.5 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.6 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Panelboards:
         1) Identify ampere rating.
         2) Identify voltage and phase.
         3) Identify power source and circuit number. Include location when not within sight of equipment.
         4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
         5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Enclosed switches and motor controllers:
         1) Identify voltage and phase.
         2) Identify power source and circuit number. Include location when not within sight of equipment.
         3) Identify load(s) served. Include location when not within sight of equipment.
   2. Service Equipment:
      a. Use identification nameplate to identify each service disconnecting means.
   3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
   4. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
      a. Service equipment.
      b. Elevator control panels.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
   3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
      a. At each source and load connection.

b. Within boxes when more than one circuit is present.
c. Within equipment enclosures when conductors and cables enter or leave the enclosure.

4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
1. Manufacturers:
a. Brimar Industries, Inc: www.brimar.com/#sle.
b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
c. Seton Identification Products: www.seton.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.
2. Materials:
a. Indoor Clean, Dry Locations: Use plastic nameplates.
b. Outdoor Locations: Use plastic or stainless steel nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
a. Exception: Provide minimum thickness of 1/8 inch (3 mm) when any dimension is greater than 4 inches (100 mm).
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Manufacturers:
a. Brady Corporation: www.bradyid.com/#sle.
b. Brother International Corporation: www.brother-usa.com/#sle.
c. Panduit Corp: www.panduit.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
2. Legend:
a. System designation where applicable:
1) Fire Alarm System: Identify with text "FIRE ALARM".
b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
a. System Designation: 1 inch (25 mm).
b. Equipment Designation: 1/2 inch (13 mm).
5. Color:
a. Normal Power System: White text on black background.
b. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).

2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch (6 mm).
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches (51 mm) by 4 inches (100 mm).
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch (13 mm).
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. HellermannTyton: www.hellermanntyton.com/#sle.
3. Panduit Corp: www.panduit.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch (3 mm).

G. Color: Black text on white background unless otherwise indicated.

2.4 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
2. Brimar Industries, Inc: www.brimar.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

C. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.

D. Legend: Type of service, continuously repeated over full length of tape.

E. Color:
   1. Tape for Buried Power Lines: Black text on red background.
   2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.5 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Insite Solutions, LLC: www.stop-painting.com/#sle.
   4. Seton Identification Products: www.seton.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conduits: Legible from the floor.
   8. Boxes: Outside face of cover.
   9. Conductors and Cables: Legible from the point of access.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 260583 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 260533.13 - Conduit for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 262726 - Wiring Devices.

E. Section 262816.16 - Enclosed Switches.

1.3 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Comply with NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 262726.

D. Flexible Conduit: As specified in Section 260533.13.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260533.16.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

B. Time switches.

C. Outdoor photo controls.

D. Daylighting controls.

E. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
   1. Includes finish requirements for wall controls specified in this section.
   2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

F. Section 262813 - Fuses.

G. Section 265100 - Interior Lighting.

H. Section 265600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

E. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2016.

F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

I. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

J. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

L. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

M. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Shop Drawings:
   1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
   2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.

D. Field Quality Control Reports.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

A. Manufacturers:
   1. As specified on drawings..
   2. Substitutions: See Section 016000 - Product Requirements.
   3. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
   6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
   7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
   8. Sensitivity: Field adjustable.
   9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
   10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
   11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
   12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.

C. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
      c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
      d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
      e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
      f. Finish: Color to be selected by Architect.

2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).

D. Wall Dimmer Occupancy Sensors:
   1. General Requirements:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
      b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
      c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
      d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
      e. Finish: Color to be selected by Architect.

E. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
      d. Finish: White unless otherwise indicated.
   2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
   3. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
      a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
      b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet (111.5 sq m) at a mounting height of 9 feet (2.7 m).

F. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
   2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
   3. Input Supply Voltage: Dual rated for 120/277 V ac.
   4. Load Rating: As required to control the load indicated on drawings.

G. Power Packs for Wireless Occupancy Sensors:
   1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
   2. Input Supply Voltage: Dual rated for 120/277 V ac.
   3. Load Rating: As required to control the load indicated on drawings.

2.3 TIME SWITCHES

A. Manufacturers:
   1. Intermatic, Inc: www.intermatic.com/#sle.
   2. NSI Industries LLC: www.nsiindustries.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Digital Electronic Time Switches:
   1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
   2. Program Capability:
      a. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
   3. Schedule Capacity: Not less than 16 programmable on/off operations.
   4. Provide automatic daylight savings time and leap year compensation.
   5. Provide power outage backup to retain programming and maintain clock.
   6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
   7. Provide remote photocell input with light level adjustment.
   8. Input Supply Voltage: As indicated on the drawings.
   9. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:
      a. Indoor clean, dry locations: Type 1.

2.4 OUTDOOR PHOTO CONTROLS

A. Manufacturers:
   1. Intermatic, Inc: www.intermatic.com/#sle.
   2. NSI Industries LLC: www.nsiindustries.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.
   4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

B. Stem-Mounted Outdoor Photo Controls:
   1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
   2. Housing: Weatherproof, impact resistant polycarbonate.
   3. Photo Sensor: Cadmium sulfide.
   4. Provide external sliding shield for field adjustment of light level activation.
   5. Light Level Activation: 1 to 5 footcandles (10.8 to 53.8 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
   6. Voltage: As required to control the load indicated on the drawings.
   7. Failure Mode: Fails to the on position.
   8. Load Rating: As required to control the load indicated on the drawings.
   9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
   1. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
   2. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Occupancy Sensor Locations:
   1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
   2. Locate dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

J. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

K. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

M. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

SECTION 262100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260533.13 - Conduit for Electrical Systems.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 262416 - Panelboards: Service entrance equipment.

H. Section 262816.16 - Enclosed Switches: Service entrance equipment.

I. Section 312316 - Excavation.

J. Section 312323 - Fill: Bedding and backfilling.

1.3 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.4 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2017.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
   2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.6 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
   1. Obtain Utility company approval of shop drawings prior to submittal.

D. Project Record Documents: Record actual locations of equipment and installed service routing.

1.7 QUALITY ASSURANCE

A. Comply with the following:
   1. IEEE C2 (National Electrical Safety Code).
   2. NFPA 70 (National Electrical Code).
   3. The requirements of the Utility Company.
   4. The requirements of the local authorities having jurisdiction.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility: Per Utility Company requirements.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Section 312316 and Section 312323.

E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 033000.

F. Provide required protective bollards in accordance with Utility Company requirements.

G. Provide required support and attachment components in accordance with Section 260529.

H. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.

I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

F. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

F. NEMA PB 1 - Panelboards; 2011.

G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

L. UL 67 - Panelboards; Current Edition, Including All Revisions.

M. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

O. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

P. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

Q. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:
   1. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Substitutions: See Section 016000 - Product Requirements.

F. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating as indicated on the drawings.
   2. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: As indicated on the drawings.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
      c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.

L. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

M. Provide the following features and accessories where indicated or where required to complete installation:
   1. Feed-through lugs.
   2. Sub-feed lugs.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum or copper.
3. Ground Bus Material: Aluminum or copper.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
4. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
   a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current exceeding Utility company available short circuit current.
   b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
   a. Provide mechanical lugs unless otherwise indicated.
   b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide the following circuit breaker types where indicated:
   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
7. Do not use tandem circuit breakers.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.5 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 260529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

I. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 260526.

K. Install all field-installed branch devices, components, and accessories.

L. Provide filler plates to cover unused spaces in panelboards.

M. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
   1. Fire detection and alarm circuits.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers. Tests listed as optional are not required.

E. Test GFCI circuit breakers to verify proper operation.

F. Test AFCI circuit breakers to verify proper operation.

G. Test shunt trips to verify proper operation.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Fan speed controllers.

D. Receptacles.

E. Wall plates and covers.

F. Floor box service fittings.

1.2 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

G. Section 262913 - Enclosed Controllers: Manual motor starters and horsepower rated motor-starting switches without overload protection.

1.3 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g, with Amendment.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

M. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Project Record Documents: Record actual installed locations of wiring devices.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

A. Provide wiring devices suitable for intended use with ratings adequate for load served.

B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.

C. Wiring Device Applications:
   1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
   2. Provide GFCI protection for:
      a. Receptacles installed within 6 feet (1.8 m) of sinks.
      b. Receptacles installed in kitchens.
      c. Receptacles serving electric drinking fountains.
   3. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.
   4. Flush Floor Service Fittings in Tile Floors: Use tile rings.
   5. Flush Floor Service Fittings in Carpeted Floors: Use carpet flanges.

D. Wiring Device Finishes:
   1. Device and coverplate materials and finish selections by Architect..

2.2 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
   3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.3 RECEPTACLES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
5. Substitutions: See Section 016000 - Product Requirements.
6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
4. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
   a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
   b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
3. USB Charging Noncombination Devices: Four-port (Type A); rectangular decorator style.

2.4 WALL PLATES AND COVERS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
   2. Intermatic, Inc: www.intermatic.com/#sle.
   3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
   4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
   5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Weatherproof Receptacle Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

E. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

F. Weatherproof Switch Covers for Wet or Damp Locations: Gasketed, metallic, with externally operable actuating means and corrosion-resistant screws; listed as suitable for use in wet locations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
   1. Mounting Heights: As indicated on the drawings.
   2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
   3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
   4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
   5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 262813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 262816.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
      a. Fusible Enclosed Switches: See Section 262816.16.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Fuses: One set(s) of three for each type and size installed.
   3. Fuse Pullers: One set(s) compatible with each type and size installed.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.2 APPLICATIONS

A. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. General Purpose Branch Circuits: Class RK1, time-delay.

C. Individual Motor Branch Circuits: Class RK1, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 262816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262813 - Fuses.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Project Record Documents: Record actual locations of enclosed switches.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB: www.electrification.us.abb.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric: www.se.com/#sle.

D. Siemens Industry, Inc: www.new.siemens.com/#sle.

E. Substitutions: See Section 016000 - Product Requirements.

F. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating.
   2. Minimum Ratings:
      a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
      b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
      a. Provide means for locking handle in the ON position.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 260529.

E. Provide required seismic controls in accordance with Section 260548.

F. Install enclosed switches plumb.

G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.

H. Provide grounding and bonding in accordance with Section 260526.

I. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

J. Identify enclosed switches in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Lamps.

F. LED replacement lamps.

G. For all existing light fixtures to remain or be relocated, the contractor shall clean all lenses, reflectors, trims, etcetera and replace all lamps, drivers and ballasts as required. Coordinate lamp color temperatures with owner and all new lamping and fixtures.

1.2 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260923 - Lighting Control Devices.
   1. Includes automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.

E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

F. Section 275129.13 - Rescue Assistance Signal Systems: Area of refuge/rescue assistance signage.

1.3 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013 (Corrigendum 2019).

B. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.

C. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.

F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2016.

H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

L. UL 1598 - Luminaires; Current Edition, Including All Revisions.

M. UL 1993 - Self-Ballasted Lamps and Lamp Adapters; Current Edition, Including All Revisions.

N. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
   2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
   3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
   4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
   2. Provide photometric calculations where luminaires are proposed for substitution upon request.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

D. Field quality control reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Substitution for specified lighting fixtures will be considered only after award of contract for a 30 day period.

1. Proposed substitutions will be accompanied by a statement setting forth any variation in contract price, should the substitution be permitted. Each proposed substitution listed will be accompanied by its ETL photometric distribution curve, coefficient of utilization, and other required data. Within seven days after the submittal, the Contractor will be prepared to submit one sample unit of each proposed substitute item accompanied with a sample of the specified item. Samples will include proper lamps, accessories, cord, and plug for operation on 120V. Failure to comply with these requirements will require the Contractor to supply the specified item only.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

C. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

D. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

B. Substitutions: See Section 016000 - Product Requirements.

2.2 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:
   1. Ceiling Compatibility: Comply with NEMA LE 4.
   2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
   3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
   1. LED Tape - General Requirements:
      a. Listed.
      b. Designed for field cutting in accordance with listing.
      c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.

J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.3 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Accessories:
   1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
   2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.4 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single- or double-face as indicated or as required for installed location.
   2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

C. Accessories:
   1. Provide compatible accessory high-impact polycarbonate vandal shields where indicated.
   2. Provide compatible accessory wire guards where indicated.

2.5 DRIVERS

A. Drivers - General Requirements:
   1. Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.
      a. Wall Dimmers: See Section 262726.

2.6 LAMPS

A. Manufacturers:
   1. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
   2. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.

B. Lamps - General Requirements:
   1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
   2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
   3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
   4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.7 LED REPLACEMENT LAMPS

A. Description: Light-emitting diode (LED) self-ballasted lamps listed as complying with UL 1993; intended for replacement of existing lamps of other light source types, including but not limited to, incandescent, fluorescent, and high intensity discharge (HID); suitable for installation in luminaire to be retrofitted.

B. LED Estimated Useful Life:
   1. Calculated based on IES LM-80 test data.

2.8 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

D. Architectural Trims for LED Lighting:
   1. Description: Trims designed for integration into architectural elements, with channels to accommodate LED tape lighting system.

E. Fire-Rated Luminaire Enclosures:
   1. Provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Check to see that all lighting fixtures are correct for the project.

B. Coordinate installation of lighting fixtures with mechanical equipment, piping, flexible wiring system, and conduit rough-ins for lighting fixtures.

C. Coordinate all lighting fixtures with ceiling types. Verify ceiling with Architect's drawings and with manufacturer's installation details for ceilings in the area to where fixtures shall be installed before ordering.

D. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

E. Verify that suitable support frames are installed where required.

F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 260529.

F. Provide required seismic controls in accordance with Section 260548.

G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

H. Suspended Ceiling Mounted Luminaires:
   1. Do not use ceiling tiles to bear weight of luminaires.
   2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
   3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
   4. Secure pendant-mounted luminaires to building structure.
   5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
   6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
   7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

I. Surface-mounted lifixtures will not have gaps between the fixture and attaching surface, except where required by code regulation. Continuous rows of fixtures shall be installed as to provide perfect alignment.

J. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Where light leaks occur, suitable gaskets shall be installed.
   3. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   4. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
   5. Plaster frames furnished by the fixture manufacturer will be provided for all recessed lighting fixtures when installed in plaster or acoustical plaster frame materials, and installation will be included in the bid under this section of the specifications.

K. Suspended Luminaires:
   1. Install using the suspension method indicated, with support lengths and accessories as required for mounting height specified by Architect.
   2. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
   3. Install canopies tight to mounting surface.
   4. Unless otherwise indicated, support pendants from swivel hangers.

L. Surface-mounted Luminaires:
   1. Lighting fixtures will be supported directly from the building structure and not from the ceiling grid system.
   2. Method of support will be in an approved manner with all thread rods, beam clamps, and pipe or Kindorf channel. Wire support and/or caddie clips will not be acceptable.
   3. The support assembly for each fixture will be capable of supporting 150 pounds indefinitely.

M. Install accessories furnished with each luminaire.

N. Bond products and metal accessories to branch circuit equipment grounding conductor.

O. Emergency Lighting Units:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

P. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

Q. Connect raceways or flexible wiring conductor to lighting fixtures.

R. Install lamps in each luminaire.

S. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

T. For all existing light fixtures to remain or be relocated, the contractor shall clean all lenses, reflectors, trims, etcetera and replace all lamps, drivers and ballasts as required. Coordinate

lamp color temperatures with owner and all new lamping and fixtures.

3.4 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.5 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.6 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish before final inspection.

3.7 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

B. See Section 017900 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 284600 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire alarm system design and installation, including all components, wiring, and conduit.

B. Maintenance of fire alarm system under contract for specified warranty period.

1.2 RELATED REQUIREMENTS

A. Section 078400 - Firestopping: Materials and methods for work to be performed by this installer.

B. Section 087100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.

C. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

D. Section 260548 - Vibration and Seismic Controls for Electrical Systems: Requirements for the seismic qualification of equipment specified in this section.

1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Proposal Documents: Submit the following with cost/time proposal:
   1. NFPA 72 "Record of Completion", filled out to the extent known at the time.

2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
3. Certification by Contractor that the system design will comply with Contract Documents.
4. Proposed maintenance contract.

C. Evidence of designer qualifications.

D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
1. Copy (if any) of list of data required by authority having jurisdiction.
2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
4. System zone boundaries and interfaces to fire safety systems.
5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
7. List of all devices on each signaling line circuit, with spare capacity indicated.
8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
12. Certification by Contractor that the system design complies with Contract Documents.

E. Evidence of installer qualifications.

F. Evidence of instructor qualifications; training lesson plan outline.

G. Evidence of maintenance contractor qualifications, if different from installer.

H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
2. Submit documentation of satisfactory inspections and tests.
3. Submit NFPA 72 "Inspection and Test Form," filled out.

I. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
4. List of recommended spare parts, tools, and instruments for testing.
5. Replacement parts list with current prices, and source of supply.
6. Detailed troubleshooting guide and large scale input/output matrix.
7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

J. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
   1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
   2. "As installed" wiring and schematic diagrams, with final terminal identifications.
   3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.

K. Closeout Documents:
   1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
   2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
   3. Certificate of Occupancy.
   4. Maintenance contract.
   5. Report on training results.

1.5 QUALITY ASSURANCE

A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer , with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.

B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
   1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
   2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
   3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.

C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.6 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Alarm Control Units and Accessories:
   1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
   2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
   3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
   4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com/#sle.
   5. Siemens Building Technologies, Inc: www.usa.siemens.com/#sle.
   6. Simplex, a brand of Johnson Controls: www.simplex-fire.com/#sle.
   7. Provide control units made by the same manufacturer.

B. Initiating Devices and Notification Appliances:
   1. Honeywell Security & Fire Solutions/Gamewell-FCI: www.gamewell-fci.com/#sle.
   2. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
   3. Honeywell Security & Fire Solutions/Notifier: www.notifier.com/#sle.
   4. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com/#sle.
   5. Siemens Building Technologies, Inc: www.sbt.siemens.com/#sle.
   6. Simplex, a brand of Johnson Controls: www.simplex-fire.com/#sle.
   7. Same manufacturer as control units.

C. Substitutions: See Section 016000 - Product Requirements.
   1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
   2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.2 FIRE ALARM SYSTEM

A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
   1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
   2. Protected PremiseAs indicated on drawings
   3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
      a. ADA Standards.
      b. The requirements of the State Fire Marshal.
      c. The requirements of the local authority having jurisdiction.
      d. Applicable local codes.
      e. Contract Documents (drawings and specifications).
      f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
   4. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
   5. Master Fire Alarm Control Unit: New, located at where shown on plans.

B. Circuits:
   1. Initiating Device Circuits (IDC): Class A, Style D.
   2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
   3. Notification Appliance Circuits (NAC): Class A, Style Z.

C. Spare Capacity:
   1. Initiating Device Circuits: Minimum 25 percent spare capacity.

2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
3. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.

D. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.

2.3 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

C. Doors:
1. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 087100.

2.4 COMPONENTS

A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.

B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

C. Addressable Fire Alarm Control Unit - Basis of Design: Potter Electric Signal Company; AFC Series; Model AFC-50; www.pottersignal.com/#sle.
1. System Capacity: 50 addresses; two (expandable to 188) notification appliance circuits (NACs); two input/output (I/O) circuits; 99 software zones.
2. Features: Strobe synchronization; dedicated alarm, supervisory and trouble relays; 4,000 event history buffer; built-in IP communicator; Ethernet port for programming and network connectivity; e-mail system status, reports and event information.

D. Master Control Unit: _____.

E. Remote Annunciators: This module shall operate on the reverse polarity principle. System alarm signals shall be sent to security alarm panel, provided by owner, for remote alarm reporting. A manual disconnect switch shall prevent transmission of alarm signals during drills. A trouble indication shall be visible until this switch is returned to normal.

F. Addressable Modules:
1. Provide addressable modules suitable for connection to fire alarm control unit signaling line circuits.
2. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
3. Monitor Modules: Unless devices are explicitly permitted to be connected together as zone, provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable fire alarm control unit.

4. Control Modules: Provide as indicated or as required for selective control of notification appliances.
5. Releasing Control Modules: Provide as indicated or as required for control of listed solenoids in releasing applications.
6. Relay Modules: Provide as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.

G. Initiating Devices:
1. Addressable Systems:
a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
2. Manual Pull Stations: Manual stations shall be dual action pull lever type requiring a key to be reset. Provide signage at each Manual Station per the Philadelphia Fire Code F-907.5.1 reading “IN CASE OF FIRE SOUND ALARM AND CALL FIRE DEPARTMENT (OR CALL 911).
3. Smoke Detectors: Ionization type Area Smoke Detectors shall operate on the dual chamber Ionization principle. The detector head shall be plug-in and mount to a twist lock base. The base shall have an indicator lamp to show when the unit has activated .
a. Provide 5 extra.
4. Heat Detectors: Thermal detectors shall be of the low profile type and compatible with all other initiation devices for operation on the same wires. The detectors shall be combination rate-of-rise and/or fixed temperature 135° unless otherwise indicated.

H. Notification Appliances:
1. Strobes: Visual strobe unit shall consist of a strobe type light semi-flush mounted in a common enclosure. Strobe lens shall have “FIRE” silk-screened. The lamp shall pulse and operate over the common alarm circuit.

I. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.

J. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

K. Locks and Keys: Deliver keys to Owner.

L. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
2. Provide one for each control unit where operations are to be performed.
3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.

B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.

C. Obtain Owner's approval of locations of devices, before installation.

D. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

A. Notify Owner 7 days prior to beginning completion inspections and tests.

B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.

D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.

E. Provide all tools, software, and supplies required to accomplish inspection and testing.

F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.3 OWNER PERSONNEL INSTRUCTION

A. Provide the following instruction to designated Owner personnel:
   1. Hands-On Instruction: On-site, using operational system.
   2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.

B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
   1. Initial Training: 1 session pre-closeout.

C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
   1. Initial Training: 1 session pre-closeout.

D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

E. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.4 CLOSEOUT

A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
   1. Be prepared to conduct any of the required tests.
   2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
   3. Have authorized technical representative of control unit manufacturer present during demonstration.

4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
2. All aspects of operation have been demonstrated to Owner.
3. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
4. Occupancy permit has been granted.
5. Specified pre-closeout instruction is complete.

3.5 MAINTENANCE

A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.

C. Provide to Owner, a proposal as an alternate to the base bid, for a maintenance contract for entire warranty period, to include the work described below; include the total cost of contract, proposal to be valid at least until 30 days after date of Substantial Completion.

D. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
3. Record keeping required by NFPA 72 and authorities having jurisdiction.

E. Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

F. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

G. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.

H. Comply with Owner's requirements for access to facility and security.

END OF SECTION